Appendix A

APPENDIX A - SOIL TYPES IN THE FIGURE FOUR PROJECT AREA

Rio Blanco County Soils

Barcus channery loamy sand (map unit 6). This deep excessively drained soil is located on alluvial fans and in narrow valleys at elevations between 5,800 and 6,800 feet amsl on slopes of 2 to 8 percent. The soil is calcareous throughout and consists of a surface layer of pale brown channery loamy sand about 6 inches thick, an underlying layer of light yellowish brown channery loamy sand about 10 inches thick, and stratified light yellowish brown and pale brown very channery sand and loamy sand to a depth of about 60 inches. The soil is characterized by rapid infiltration, slow runoff, and a low available water capacity. The water erosion hazard is moderate.

Castner channery loam (map unit 15). This shallow, well-drained soil is located on mountainsides, ridgetops, and uplands at elevations between 6,900 and 7,800 feet amsl on slopes of 5 to 50 percent. The soil consists of a surface layer of dark grayish-brown channery loam about 7 inches thick, an underlying layer of dark grayish-brown very channery loam about 4 inches thick, and grayish-brown calcareous very channery loam to depth of about 10 to 20 inches. The soil is characterized by moderate infiltration, medium to rapid runoff, and a very low available water capacity. The water erosion hazard is moderate to very high.

Forelle loam (map unit 33). This deep well-drained soil is located on terraces and uplands at elevations between 5,800 and 7,200 feet amsl on slopes of 3 to 8 percent. The soil consists of a surface layer of pale brown loam about 4 inches thick, an underlying layer of yellowish brown clay loam about 12 inches thick, and very pale brown loam to a depth of about 60 inches. The soil is characterized by moderate infiltration and runoff, and a high available water capacity. The water erosion hazard is moderate.

Glendive fine sandy loam (map unit 36). This deep well-drained soil is located along drainageways on alluvial valley floors at elevations between 5,800 and 7,200 feet amsl on slopes of 2 to 4 percent. The soil is calcareous throughout and consists of a surface layer of pale brown fine sandy loam about 6 inches thick and very pale brown, stratified fine sandy loam to a depth of about 60 inches. The soil is characterized by moderately rapid infiltration, slow runoff, and a moderate available water capacity. The water erosion hazard is slight and the soil is subject to rare periods of flooding.

Hagga loam (map unit 40). This deep poorly-drained soil is located on floodplains and alluvial valley floors at elevations between 5,800 and 7,200 feet amsl on slopes of 0 to 5 percent. The soil consists of a surface layer of light brownish gray loam about 5 inches thick and stratified silt clay loam to loamy fine sand to a depth of about 60 inches. The soil is characterized by moderately slow infiltration, slow runoff, and a high available water capacity. The water erosion hazard is slight and the soil is subject to brief periods of flooding in the spring and summer.

Havre loam (map unit 41). This deep well-drained soil is located on floodplains and alluvial low stream terraces at elevations between 5,800 and 7,200 feet amsl on slopes of 0 to 4 percent. The soil consists of a surface layer of light brownish gray loam about 21 inches thick and stratified light gray loam and silt clay loam to a depth of about 60 inches. The soil is characterized by moderate infiltration, moderate runoff, and a high available water capacity. The water erosion hazard is slight and the soil is subject to brief periods of flooding in the spring and summer.

Irigul channery loam (map unit 42). This shallow well-drained soil is located on ridges and mountainsides at elevations between 7,600 and 8,700 feet amsl on slopes of 5 to 50 percent. The soil consists of a surface layer of grayish brown channery loam about 5 inches thick and brown extremely channery loam about 7 inches thick. Hard sandstone is at a depth of 12 inches. The soil is characterized by moderate infiltration, moderate to rapid runoff, and a very low available water capacity. The water erosion hazard is very high.

Irigul-Parachute complex (map unit 43). This map unit is located on ridges and mountainsides at elevations between 7,600 and 8,500 feet amsl on slopes of 5 to 30 percent. The unit is 60 percent Irigul loam and 30 percent Parachute loam. The Irigul soil is shallow and well-drained, with a surface layer of grayish brown channery loam about 5 inches thick and brown extremely channery loam about 7 inches thick. Hard sandstone is at a depth of 12 inches. Permeability of the Irigul soil is moderate and available water capacity is very low. Runoff is medium to rapid and the water erosion hazard is slight to high. The Parachute soil is moderately deep and well-drained. The surface layer is grayish-brown loam 4 inches thick. The upper 20 inches of subsoil is grayish-brown loam and channery loam and the lower 8 inches is pale brown very channery loam. Sandstone is at a depth of 38 inches. Permeability of the Parachute soil is moderate and available water capacity is low. Runoff is medium and the water erosion hazard is moderate to very high.

Northwater loam (map unit 56). This deep well-drained soil is located on mountainsides at elevations between 7,700 and 8,400 feet amsl and on slopes of 5 to 50 percent. The surface is typically covered with a mat of partially decomposed leaves about 2 inches thick. The surface layer is grayish brown loam about 20 inches thick. The upper part of the subsoil consists of brown loam about 5 inches thick and the lower part is pale brown very channery loam about 6 inches thick. Fractured sandstone is at a depth of 47 inches. The soil is characterized by moderate infiltration, medium runoff, and a moderate available water capacity. The water erosion hazard is moderate to very high.

Parachute loam (map unit 58). This moderately deep, well-drained soil is located on ridges and mountainsides at elevations between 7,500 and 8,700 feet amsl on slopes of 25 to 75 percent. The surface layer is grayish-brown loam 4 inches thick. The upper 10 inches of subsoil is loam followed by 10 inches of channery loam and 8 inches of very channery loam. Fractured sandstone is at a depth of 38 inches. Permeability is moderate and available water capacity is low. Runoff is medium and the water erosion hazard is very high.

Parachute-Rhone loams (map unit 59). This map unit is located on mountainsides and upland ridges at elevations between 7,600 and 8,600 feet amsl on slopes of 5 to 30 percent. The unit is 55 percent Parachute loam and 35 percent Rhone loam. The Parachute soil is moderately deep and well-drained. The surface layer is grayish-brown loam 4 inches thick. The upper 10 inches of subsoil is loam followed by 10 inches of channery loam and 8 inches of very channery loam. Fractured sandstone is at a depth of 38 inches. Permeability of the Parachute soil is moderate and available water capacity is low. Runoff is medium and the water erosion hazard is moderate to high. The Rhone soil is deep and well-drained. The upper part of the surface layer is dark grayish brown loam about 8 inches thick, the next layer is 16 inches of dark grayish brown loam, and the lower part is grayish brown very channery loam about 16 inches thick. The substratum is brown very channery loam 10 inches thick. Fractured sandstone is at a depth of about 50 inches. Permeability of the Rhone soil is moderate and available water capacity is high. Runoff is medium and the water erosion hazard is moderate to high.

Piceance fine sandy loam (map unit 64). This moderately deep, well-drained soil is located on uplands and broad ridgetops at elevations between 6,300 and 7,500 feet amsl on slopes of 5 to 15 percent. The surface layer is brown fine sandy loam 4 inches thick. The upper 5 inches of subsoil is brown loam followed by 13 inches of light yellowish brown loam. The substratum is very pale brown channery loam about 8 inches thick. Hard sandstone is at a depth of 30 inches. Permeability is moderate and available water capacity is moderately low. Runoff is slow to medium and the water erosion hazard is moderate to high.

Redcreek-Rentsac complex (map unit 70). This map unit is located on mountainsides and ridges at elevations between 6,000 and 7,400 feet amsl on slopes of 5 to 30 percent. The unit is 60 percent Redcreek sandy loam and 30 percent Rentsac channery loam. The Redcreek soil is shallow and well-drained. The surface layer is brown sandy loam 4 inches thick. The next layer is calcareous sandy loam about 7 inches thick. The underlying material is very pale brown, calcareous channery loam about 5 inches thick. Hard sandstone is at a depth of 16 inches. Permeability of the Redcreek soil is moderate and available water capacity is very low. Runoff is medium and the water erosion hazard is moderate to high. The Rentsac soil is shallow and well-drained. The upper part of the surface layer is grayish brown channery loam about 5 inches thick, the next layer is 4 inches of brown very channery loam, and the underlying material is very pale brown extremely flaggy loam 7 inches thick. Hard sandstone is at a depth of about 16 inches. Permeability of the Rhone soil is moderate and available water capacity is very low. Runoff is medium and the water erosion hazard is moderate to high.

Rentsac channery loam (map unit 73). This shallow well-drained soil is located on ridges, foothills, and sideslopes at elevations between 6,000 and 7,600 feet amsl on slopes of 5 to 50 percent. The upper part of the surface layer is grayish brown channery loam about 5 inches thick, the next layer is 4 inches of brown very channery loam, and the underlying material is very pale brown extremely flaggy loam 7 inches thick. Hard sandstone is at a depth of about 16 inches. Permeability of the Rhone soil is moderate and available water capacity is very low. Runoff is rapid and the water erosion hazard is moderate to very high.

Rhone loam (map unit 76). This deep, well-drained soil is located on mountainsides, upland ridges, and sideslopes at elevations between 7,600 and 8,600 feet amsl on slopes of 30 to 75 percent. The upper part of the surface layer is dark grayish brown loam about 8 inches thick, the next layer is 16 inches of dark grayish brown loam, and the lower part is grayish brown very channery loam about 16 inches thick. The substratum is brown very channery loam 10 inches thick. Fractured sandstone is at a depth of about 50 inches. Permeability is moderate and available water capacity is high. Runoff is medium and the water erosion hazard is very high.

Silas loam (map unit 82). This deep, well-drained soil is located in the bottom of narrow mountain valleys at elevations between 7,300 and 8,500 feet amsl on slopes of 0 to 8 percent.

The upper part of the surface layer is dark gray loam about 4 inches thick, and the lower part is dark gray loam about 20 inches thick. The underlying material is stratified, dark gray loam and dark gray sandy clay loam to a depth of 60 inches or more. Permeability is moderate and available water capacity is high. Runoff is medium and the water erosion hazard is slight to moderate.

Starman-Vandamore complex (map unit 87). This map unit is located on rolling ridges and windswept ridgetops at elevations between 7,500 and 8,900 feet amsl on slopes of 5 to 40 percent. The unit is 50 percent Starman channery loam and 40 percent Vandamore channery loam. The Starman soil is shallow and well-drained. The surface layer is grayish-brown channery loam 2 inches thick. The upper 6 inches of the underlying material is pale brown extremely channery loam, and the lower part is very pale brown extremely channery loam about 9 inches thick. Hard shale is at a depth of 17 inches. Permeability of the Starman soil is moderate and available water capacity is very low. Runoff is medium and the water erosion hazard is moderate to very high. The hazard of soil blowing is moderate to high. The Vandamore soil is moderately deep and well-drained. The surface layer is light grayish brown very channery loam about 4 inches thick, and the next layer is 4 inches of light brownish-gray very channery loam. The underlying material is very pale brown extremely channery loam 17 inches thick. Sandstone is at a depth of about 25 inches. Permeability of the Vandamore soil is moderate and available water capacity is very low. Runoff is medium and the water erosion hazard is moderate to very high. The hazard of soil blowing is moderate to high.

Torriorthents-Rock outcrop complex (map unit 91). This map unit is located on extremely rough and eroded areas on mountains, hills, ridges, and canyonsides at elevations between 5,100 and 7,500 feet amsl. The unit is 50 percent Torriorthents on slopes of 15 to 65 percent and 30 percent rock outcrop on slopes of 35 to 90 percent. Torriorthents are very shallow to moderately deep and well-drained to somewhat excessively drained. Torriorthents are calcareous throughout and highly variable with no single profile being typical. In some areas the surface layer is stony or flaggy. Permeability is moderate and available water capacity is very low. Runoff is very rapid and the water erosion hazard is very high. Rock outcrop consists of barren escarpments, ridge caps, and points of sandstone, shale, limestone, or siltstone.

Veatch channery loam (map unit 96). This moderately deep well-drained soil is located on mountainsides at elevations between 6,500 and 7,500 feet amsl on slopes of 12 to 50 percent. The surface layer is dark brown channery loam about 8 inches thick. The upper 5 inches of the subsoil is dark brown channery loam and the lower 5 inches is brown channery loam. The underlying material is very pale brown extremely channery light loam 14 inches thick. Sandstone is at a depth of about 32 inches. Permeability is moderate and available water capacity is moderate. Runoff is medium and the water erosion hazard is moderate to very high.

Yamac loam (map unit 104). This deep well-drained soil is located on rolling uplands, terraces, and fans at elevations between 5,800 and 7,100 feet amsl on slopes of 2 to 15 percent. The surface layer is brown loam about 4 inches thick. The upper 8 inches of the subsoil is brown loam and the lower 10 inches is highly calcareous loam. The upper 26 inches of the substratum is very pale brown loam and the lower part to a depth of 60 inches or more is pale brown loam. Permeability is moderate and available water capacity is moderate to high. Runoff is medium and the water erosion hazard is slight to moderate.

Garfield County Soils

Irigul-Starman channery loams (map unit 50). This map unit is located on mountain ridges and the crests and sides of hills at elevations between 7,800 and 8,400 feet amsl on slopes of 5 to 30 percent. The unit is 40 percent Irigul loam and 30 percent Starman soil. The Irigul soil is shallow and well-drained, with a surface layer of grayish brown channery loam about 6 inches thick and brown extremely channery loam about 7 inches thick. Hard sandstone is at a depth of 13 inches. Permeability of the Irigul soil is moderate and available water capacity is very low. Runoff is medium to rapid and the water erosion hazard is moderate to very severe. The Starman soil is shallow and well-drained. The surface layer is grayish-brown channery loam 2 inches thick. The upper 6 inches of the underlying material is pale brown extremely channery loam, and the lower part is very pale brown extremely channery loam about 5 inches thick. Hard shale is at a depth of 11 inches. Permeability of the Starman soil is moderate and available water capacity is very low. Runoff is medium to rapid and the water erosion hazard is moderate to very severe.

Northwater-Adel complex (map unit 52). This map unit is located on mountainsides and footslopes at elevations between 7,700 and 8,400 feet amsl on slopes of 5 to 50 percent. The unit is 50 percent Northwater soil and 40 percent Adel soil. The Northwater soil consists of a surface layer of grayish brown loam about 28 inches thick. The subsoil consists of yellowish-brown very channery loam about 20 inches thick. The substratum to a depth of 60 inches or more is yellowish-brown extremely channery loam. The soil is characterized by moderate infiltration, medium to rapid runoff, and a moderate available water capacity. The water erosion hazard is severe to very severe. The Adel soil is deep and well-drained. The surface layer is dark grayish brown clay loam about 20 inches thick. The subsoil is brown clay loam about 11 inches thick and the substratum to a depth of 60 inches or more is brown clay loam. Permeability is moderate and available water capacity is high. Runoff is medium and the water erosion hazard is severe to very severe.

Parachute-Irigul complex (map unit 55). This map unit is located on ridges and mountainsides at elevations between 7,600 and 8,800 feet amsl on slopes of 5 to 30 percent. The unit is 60 percent Parachute soil and 30 percent Irigul soil. The Parachute soil is moderately deep and well-drained. The surface layer is grayish-brown loam 10 inches thick. The subsoil is brown very channery loam about 15 inches thick. Fractured sandstone is at a depth of about 25 inches. Permeability of the Parachute soil is moderate and available water capacity is very low. Runoff is medium to rapid and the water erosion hazard is moderate to very severe. The Irigul soil is shallow and well-drained, with a surface layer of brown channery loam about 6 inches thick and brown very channery loam about 7 inches thick. Hard siltstone is at a depth of 13 inches. Permeability of the Irigul soil is moderate and available water capacity is very low. Runoff is medium to rapid and the water erosion hazard is moderate to very severe.

Parachute-Irigul-Rhone association (map unit 56). This map unit is located on ridges and mountainsides at elevations between 7,600 and 8,800 feet amsl on slopes of 25 to 50 percent. The unit is 35 percent Parachute soil, 30 percent Irigul soil, and 20 percent Rhone soil. The Parachute soil is on north- and west-facing sideslopes, the Irigul soil is on ridges and south- and east-facing sideslopes, and the Rhone soil is on toeslopes. The Parachute soil is moderately deep and well-drained. The surface layer is grayish-brown loam 10 inches thick. The subsoil is brown very channery loam about 15 inches thick. Fractured sandstone is at a depth of about 25 inches. Permeability of the Parachute soil is moderate and available water capacity is very low. Runoff is medium to rapid and the water erosion hazard is moderate to very severe. The Irigul soil is shallow and well-drained, with a surface layer of brown channery loam about 6 inches thick and brown very channery loam about 7 inches thick. Hard shale is at a depth of 13 inches. Permeability of the Irigul soil is moderate and available water capacity is very low. Runoff is medium to rapid and the water erosion hazard is moderate to very severe. The Rhone soil is deep and well-drained. The surface layer is very dark grayish-brown loam 10 inches thick. The subsoil is dark grayish brown very channery loam about 16 inches thick. Fractured sandstone is at a depth of about 55 inches. Permeability of the Rhone soil is moderate and available water capacity is moderate. Runoff is rapid and the water erosion hazard is very severe.

Parachute-Rhone loam (map unit 57). This map unit is located on ridge crests, mountainsides, upland slopes, and sideslopes at elevations between 7,600 and 8,800 feet amsl on slopes of 5 to 30 percent. The unit is 55 percent Parachute loam and 35 percent Rhone loam. The Parachute soil is on north- and west-facing sideslopes, the Irigul soil is on ridges and south- and east-facing sideslopes, and the Rhone soil is on toeslopes. The Parachute soil is moderately deep and well-drained. The surface layer is grayish-brown loam 10 inches thick. The subsoil is brown very channery loam about 15 inches thick. Fractured sandstone is at a depth of about 25 inches. Permeability of the Parachute soil is moderate and available water capacity is very low. Runoff is medium to rapid and the water erosion hazard is moderate to very severe. The Rhone soil is deep and well-drained. The surface layer is very dark grayish-brown loam 10 inches thick. The next layer is dark grayish brown channery loam about 29 inches thick. The subsoil is brown very channery loam about 16 inches thick. Fractured sandstone is at a depth of about 55 inches. Permeability of the Rhone soil is moderate and available water capacity is moderate. Runoff is medium to rapid and the water erosion hazard is moderate to very severe.

Silas loam (map unit 63). This deep, well-drained soil is located on alluvial valley floors at elevations between 7,800 and 8,400 feet amsl on slopes of 1 to 12 percent. The surface layer is dark grayish brown loam about 18 inches thick. The upper part of the underlying material is dark grayish brown clay loam about 27 inches thick, and the lower part is grayish brown clay loam to a depth of 60 inches or more. Permeability is moderate and available water capacity is high. Runoff is slow and the water erosion hazard is slight to very severe.

Torriorthents-warm-Rock outcrop complex (map unit 66). This map unit is located on steep, mainly south-facing slopes of mountains, hills, ridges, and canyonsides in extremely rough and eroded areas at elevations between 6,200 and 8,500 feet amsl. The unit is 50 percent Torriorthents and 40 percent rock outcrop. Torriorthents are very shallow to moderately deep and well-drained to somewhat excessively drained. Torriorthents are calcareous throughout and highly variable with no single profile being typical. In some areas the surface layer is stony or flaggy. Permeability is moderate and available water capacity is very low to moderate. Runoff is very rapid and the water erosion hazard is very severe. Rock outcrop consists of barren escarpments, ridge caps, and points of sandstone, shale, limestone, or siltstone.

Tosca channery loam (map unit 67). This deep, well-drained soil is located on mountain sideslopes at elevations between 6,200 and 8,500 feet amsl on slopes of 25 to 80 percent. The surface layer is dark grayish brown channery loam about 8 inches thick. The next layer is brown very channery loam about 7 inches thick. The upper part of the underlying material is brown very channery loam about 9 inches thick, and the lower part is very pale brown very channery loam to a depth of 60 inches or more. Permeability is moderate and available water capacity is low. Runoff is rapid and the water erosion hazard is very severe.

Wrayha-Rabbitex-Veatch complex (map unit 75). This map unit is located on canyon sideslopes at elevations between 5,800 and 7,600 feet amsl on slopes of 45 to 65 percent. The unit is 35 percent Wrayha soil, 20 percent Rabbitex soil, and 20 percent Veatch soil. The three soils are intermingled. The Wrayha soil is deep and well-drained. The surface layer is grayish-brown gravelly sandy loam about 4 inches thick. The upper part of the underlying material is pale olive clay loam about 24 inches thick. The next layer is reddish gray silty clay loam about 21 inches thick. The lower part of the underlying material to a depth of 60 inches or more is grayish brown silty clay loam. Permeability of the Wrayha soil is slow and available water capacity is moderate. Runoff is rapid and the water erosion hazard is very severe. The Rabbitex soil is deep and well-drained, with a surface layer of brown loam about 7 inches thick. The upper part of the subsoil is light gray loam about 8 inches thick and the lower portion is grayish brown silty clay loam to a depth of 60 inches or more. Permeability of the Rabbitex soil is moderate and available water capacity is high. Runoff is rapid and the water erosion hazard is very severe. The Veatch soil is moderately deep and well-drained. The surface layer is dark grayish-brown loam about 6 inches thick. The upper part of the subsoil is dark grayish brown loam about 5 inches thick and the lower part is pale brown very channery sandy loam about 21 inches thick. Sandstone is at a depth of about 32 inches. Permeability of the Veatch soil is moderate and available water capacity is low. Runoff is medium and the water erosion hazard is very severe.

Appendix B

APPENDIX B - CDOW DEFINED BIG GAME RANGE CATEGORIES.

Range Category	Description
Overall Range	The area which encompasses all known seasonal activity areas within the observed range of a species population.
Winter Range	That part of the overall range of a species where 90% of the individuals are located during the average five winters out of ten from the first heavy snowfall to spring green-up, or during a site specific period of winter as defined for each DAU.
Severe Winter Range	That part of the range of species where 90% of the individuals are located when the annual snowpack is at its maximum and/or temperatures are at a minimum in the two worst winters out of ten.
Production Area	The part of the overall range of a species occupied by the females from May 15 to June 15 for calving
Resident Population Area	An area used year-round by a population. Individuals could be found in any part of the area at any time of the year; the area can not be divided into seasonal ranges.
Summer Range	The part of the range of a species where 90% of the individuals are located between spring green-up and the first heavy snowfall, or during a site specific period of summer as defined for each DAU. Summer range is not necessarily exclusive of winter range.

Colorado Division of Wildlife – Natural Diversity Information Source. 1999.
http://ndis1.nrel.colostate.edu/ndis/ftp_html_site/ftp.asp

Appendix C

APPENDIX C - POTENTIAL RAPTOR SPECIES OCCURRING IN OR NEAR THE FIGURE FOUR PROJECT AREA

Common Name	Scientific Name
Red-tailed Hawk	*Buteo jamaicensis*
Cooper's Hawk	*Accipiter cooperii*
Sharp-shinned Hawk	*Accipiter striatus*
Northern Goshawk	*Accipiter gentilis*
American Kestrel	*Falco sparverius*
Prairie Falcon	*Falco mexicanus*
Peregrine Falcon	*Falco peregrinus*
Golden Eagle	*Aquila chrysaetos*
Bald Eagle	*Haliaeetus leucocephalus*
Northern Harrier	*Circus cyaneus*
Swainson's Hawk	*Buteo swainsoni*
Turkey Vulture	*Cathartes avia*
Flammulated Owl	*Otus flammeolus*
Great-horned Owl	*Bubo virginianus*
Northern Pygmy Owl	*Glaucidium gnoma*
Northern saw-whet Owl	*Aegolius acadicus*

Kingery, H.E. (ed.). 1998. Colorado Breeding Bird Atlas. Colorado Breeding Bird Atlas Partnership, Denver. 636pp.

Appendix D

Buys & Associates, Inc. **Environmental Consultants**	Project: Encana - Figure 4 Field Development EA

Development Summary

Construction/ Drilling/ Completion

For EA analysis, assume surface disturbance of 5 acres per pad
By 2006, 125 pads and 332 wells, 141 MMscfd production

55 pads in 2004	45%
30 pads in 2005	25%
40 pads in 2006	30%

Maximum scenario development rate: 55 pads and 33 wells drilled
50 miles of new roads 22.5 in 2004; 12.5 in 2005; 15.0 in 2006
Maximum road development: 22.5 miles in 2004
Road ROW 30 ft with 18-ft running surface
Assume 625 acres for well pads (125 pads * 5 acres/pad)
Assume 182 acres for road (50 miles *5280 ft/mile * 30 ft ROW)
Average access road 0.41 mile = 0.41 miles x 5280 ft/mile x 30 ft ROW = 1.45 acres
Average Round Trip Distance for Construction/Drilling/Completion Traffic = 24 miles (estimated from project area road system)
Average drilling time = 30 days (based on Proponent's estimated 25-35 days)
Average completion time = 10 days

Production

Separator for each well
Boiler size for separators: 750 Mbtu
Assume 95% destruction efficiency for dehy's to meet and federal MACT stds.
Condensate tanks - 200 to 500 barrels
Condensate production - 4 barrels/day/well
332 wells by year end 2006
90 MMscfd by end of 2006 - average 0.27 MMscfd per well
Compressor station 12,800 hp by 2006
Comp Building = 40 meters x 20 meters x 6 meters high

Well Pad and Access Road Construction Emissions (Dozer and Backhoe)

Assumptions:

Well Pad and Access Road Area	6.45	acres (Proposed Action)
Hours of Construction	10	days per well pad (Proponent)
	8	hours/day
	80	hours per well pad
Watering Control Efficiency	50	percent
Soil Moisture Content	7.9	percent (AP-42 Table 11.9-3, 10/98)
Soil Silt Content	6.9	percent (AP-42 Table 11.9-3, 10/98)
PM10 Multiplier	0.75 * PM15	(AP-42 Table 11.9-1, 10/98)
PM2.5 Multiplier	0.105 * TSP	(AP-42 Table 11.9-1, 10/98)
Pad Development Rate	55	pads per year - indicates max the first year

Equations: From AP-42 tables 11.9-1 and 11.9-3 for
Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98

Emissions (TSP lbs/hr) = 5.7 * (soil silt content %)^1.2 * (soil moisture content %)^-1.3* Control Efficiency

Emissions (PM15 lbs/hr) = 1.0 * (soil silt content %)^1.5 * (soil moisture content %)^-1.4 * Control Efficiency

Emissions = 1.97 lbs TSP/hour/piece of equipment

Emissions = 0.50 lbs PM15/hour/piece of equipment

	Dozer and Backhoe Emissions [a]		
	lbs/hr	**lb/day/well**	**tons/yr [b]**
TSP	3.94	31.5260	69.36
PM15	1.00	8.0294	17.66
PM10	0.75	6.0221	13.25
PM2.5	0.41	3.3102	7.28

a Assumes one dozer and one backhoe. Backhoe emissions are conservatively estimated as equivalent to Dozer emissions.

b Assumes the maximum construction rate

Buys & Associates, Inc. Environmental Consultants	Project: Encana - Figure 4 Field Development EA

Well Pad and Road Construction Emissions (Grader)

Assumptions:

Grading Length	4.51	0.41 miles/road plus 4.1 miles on 466ft^2 pad (10 ft swath for 466 ft * 46 lenghts) = 21,436 ft = 4.1 miles
Hours of Construction	1	days grading per well pad and road (Proponent Estimate)
	8	hours/day
	8	hours per well pad
Watering Control Efficiency	50	percent
Average Grader Speed	10	mph (Typical value)
Distance Graded	4.51	miles
PM10 Multiplier	0.6 * PM15	(AP-42 Table 11.9-1, 10/98)
PM2.5 Multiplier	0.031 * TSP	(AP-42 Table 11.9-1, 10/98)
Pad/Road Development Rate	55	per year - max during first year

Equations: From AP-42 tables 11.9-1 and 11.9-3 for Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98

Emissions (TSP lbs) = $0.040 * (\text{Mean Vehicle Speed})^{2.5} * \text{Distance Graded} * \text{Control Efficiency}$

Emissions (PM15 lbs) = $0.051 * (\text{Mean Vehicle Speed})^{2.0} * \text{Distance Graded} * \text{Control Efficiency}$

Emissions = 28.52 lbs TSP/well

Emissions = 11.50 lbs PM15/well

	Grader Construction Emissions			
	lbs/well	**lbs/day/well**		**tons/yr [a]**
TSP	28.52	28.52		0.78
PM15	11.50	11.50		0.32
PM10	6.90	6.90		0.19
PM2.5	0.88	0.88		0.02

a Assumes the maximum construction rate

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Environmental Consultants

Project: Encana - Figure 4 Field Development EA

Construction Traffic Fugitive Dust Emissions

Calculation AP-42, Chapter 13.2.1
December 2003

E (PM10) / VMT = 1.5 * (S/12)^0.9 * (W/3)^0.45 * (365-p)/365)
E (PM2.5) / VMT = 0.23 * (S/12)^0.9 + (W/3)^0.45
Silt Content (S) 11
Round Trip Miles 24
Precipitation Days (P) 88 WRCC Little Hills

	Vehicle Type	Average Weight (lbs)	Round Trips per Well	PM10 (lb/VMT)	PM10/Pad (lbs)	PM10/Pad (lb/day)	PM2.5/Pad (lbs)	PM2.5/Pad (lb/day)
Construction (days/pad and road)	10							
	Semi: Hvy Equip Hauler	74,000	3					
	Haul Truck:Gravel	48,000	2					
	Pickup Truck: Crew	7,000	10					
	Mean Vehicle Weight	25,867	15	2.031578	731.4	73.1	112.1	11.2
					PM10/55 Pads (tons)		**PM2.5/55 Pads (tons)**	
					20.1		3.1	

	Vehicle Type	Average Weight (lbs)	Round Trips per Well	PM10 (lb/VMT)	PM10/Well (lbs)	PM10/Well (lb/day)	PM2.5/Well (lbs)	PM2.5/Well (lb/day)
Drilling (days/well)	30							
	Semi: Rig Transport	60,000	22					
	Haul Truck:Fuel	48,000	55					
	Haul Truck: Mud	48,000	8					
	Logging Trucks	48,000	4					
	Haul Truck: Gravel	48,000	2					
	Haul Truck: Water	20,000	20					
	Pickup Truck: Rig Crew	7,000	110					
	Pickup Truck: Mechanic	8,000	8					
	Pickup Truck: Supervisor	7,000	8					
	Pickup Truck: Mud Logger	8,000	110					
	Pickup: Mud Engineer	7,000	55					
	Pickup: Bit/Tool Delivery	8,000	16					
	Mean Vehicle Weight	19,079	418	1.771536	17772.0	592.4	2725.0	90.8
					PM10/33 Wells (tons)		**PM2.5/33 Wells (tons)**	
					293.2		45.0	

	Vehicle Type	Average Weight (lbs)	Round Trips per Well	PM10 (lb/VMT)	PM10/Well (lbs)	PM10/Well (lb/day)	PM2.5/Well (lbs)	PM2.5/Well (lb/day)
Completion (days/well)	10							
	Semi: Casing	74,000	6					
	Cement Haul Trucks	74,000	6					
	Cement Pump Truck	48,000	2					
	Completion Rig	74,000	1					
	Completion Rig Equip Truck	48,000	4					
	Frac Trucks	80,000	12					
	Haul: Frac Tanks	48,000	6					
	Haul: Frac Sand	44,000	30					
	Haul: Frac Chemicals	44,000	4					
	Logging/Perf. Truck	48,000	8					
	Pickup: Comp.Foreman	7,000	40					
	Pickup: Casing Crews	7,000	4					
	Pickup: Cement Crew	8,000	4					
	Pickup: Completion Rig Crew	7,000	20					
	Pickup: Frac Crew	7,000	4					
	Pickup: Logging/Perf Crew	7,000	8					
	Welders	8,000	4					
	Roustabout Crews	8,000	4					
	Supply Trucks	8,000	16					
	Mean Vehicle Weight	28,055	183	2.107184	9254.8	925.5	1419.1	141.9
					PM10/33 Wells (tons)		**PM2.5/33 Wells (tons)**	
					152.7		23.4	

	Vehicle Type	Average Weight (lbs)	Round Trips per Well	PM10 (lb/VMT)	PM10/Day (lbs)	PM10/Day (lb/day)	PM2.5/Day (lbs)	PM2.5/Day (lb/day)
Field Development (days/pipeline mile)	1							
	Gathering Sys. Const. Crew	8,000	4					
	Haul Truck: Trencher	48,000	1					
	Haul Truck: Pipe	48,000	6					
	Surveyor	7,000	1					
	Welder	8,000	4					
	Reclamation Crew	8,000	1					
	Mean Vehicle Weight	24,412	17	1.979338	807.6	807.6	123.8	123.8
					PM10/22 Days (tons)		**PM2.5/22 Days (tons)**	
					9.1		1.4	

Annual Traffic Fugitive Dust Emissions (tons/year)	**475.14**	**72.85**

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Wind Erosion Fugitive Dust Emissions

Assumptions

Threshold Friction Velocity U_t*	1.02 m/s (2.28 mph) for well pads (AP-42 Table 13.2.5-2 Overburden - Western Surface Coal Mine 1.33 m/s (2.97 mph) for roads (AP-42 Table 13.2.5-2 Roadbed material)
Initial Disturbance Area	625.0 acres total initial disturbance for pads 2,529,281 square meters total initial disturbance for roads
Exposed Surface Type	Flat
Meteorological Data	2002 Grand Junction (obtained from NCDC website)
Fastest Mile Wind Speed U_{10}^+	20.1 meters/sec (45 mph) reported as fastest 2-minute wind speed for Grand Junction (2002)
Number soil of disturbances	2 for well pads and pipelines(Proposed Action assumption, disturbance at construction and reclamation) Constant for dirt roads
Development Period	3 years (Proposed Action - 125 pads)

Equations

Friction Velocity $U^* = 0.053\ U_{10}^+$

Erosion Potential P (g/m^2/period) = $58*(U^*-U_t^*)^2 + 25*(U^*-U_t^*)$ for $U^*>U_t^*$, P = 0 for $U^*< U_t^*$

Emissions (tons/year) = Erosion Potential(g/m^2/period)*Disturbed Area(m^2)*Disturbances/year*(k)/(453.6 g/lb)/2000 lbs/ton/Develop Period

Particle Size Multiplier (k)

30 um	<10 um	<2.5 um
1.0	0.5	0.2

Maxium U_{10}^+ Wind Speed (m/s)	Maximum U* Friction Velocity m/s	Well/Pipeline U_t* Threshold Velocity[a] m/s	Well Pad Erosion Potential g/m^2	Road U_t* Threshold Velocity[a] m/s	Road Erosion Potential g/m^2
20.12	1.07	1.02	1.28	1.33	0.00

Wind Erosion Emissions	
Particulate Species	Pads (tons/year)
TSP	2.38
PM10	1.19
PM2.5	0.48

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Construction Related Light Vehicle Tailpipe Emissions

Assumptions:

Average Round Trip Distance	24.0	miles (Estimated from Project Area and existing road system)
Days of Construction	10	days (Proponent)
Number of Heavy Diesel Truck Trips	5	(Estimated)
Number of Pickup Trips	5	(Estimated)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)
Pad Development Rate	55	pads per year

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{453.6\ \text{(g/lb)} * 2000\ \text{(lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * 453.6\ \text{(g/lb)} * \text{Fuel Sulfur Content} * 2\ \text{(S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Construction Vehicles	**Heavy Haul Trucks**			**Heavy Duty Pickups**			**Total** [d]	
	E. Factor [a] (g/mile)	Emissions (lb/day)	Emissions (tons/yr/well)	E. Factor [b] (g/mile)	Emissions (lb/day)	Emissions (tons/yr/well)	Emissions (lb/day)	Emissions (tons/yr)
NOx	8.13	0.215	0.001	3.03	0.080	0.000	0.295	0.081
CO	17.09	0.452	0.002	33.64	0.890	0.004	1.342	0.369
VOC [c]	4.83	0.128	0.001	1.84	0.049	0.000	0.176	0.049
SO2	0.32	0.008	0.000	0.21	0.006	0.000	0.014	0.004

a AP-42 Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons.
d Assumes the maximum development rate

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Drilling Related Vehicle Tailpipe Emissions

Assumptions:

Average Round Trip Distance 24.0 miles (Estimated from project area and existing road system)

Days of Operation 30 hours per site (Project Proponent)

Number of Heavy Diesel Truck Trips 111 (Estimated from project description)

Number of Pickup Trips 307 (Estimated from project description)

Diesel Fuel sulfur content 0.05 % (Typical value)

Diesel Fuel density 7.08 lbs/gallon (Typical value)

Heavy Haul Diesel Fuel Efficiency 10 miles/gallon (Typical value)

Heavy Duty Pickup Fuel Efficiency 15 miles/gallon (Typical value)

Well Development Rate 33 wells per year

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{453.6\ \text{(g/lb)} * 2000\ \text{(lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * 453.6\ \text{(g/lb)} * \text{Fuel Sulfur Content} * 2\ \text{(S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Drilling Vehicles	**Heavy Haul Trucks**			**Heavy Duty Pickups**			**Total [d]**	
	E. Factor [a] (g/mile)	Emissions (lb/day)	Emissions (tons/yr/well)	E. Factor [b] (g/mile)	Emissions (lb/day)	Emissions (tons/yr/well)	Emissions (lb/day)	Emissions (tons/yr)
NOx	8.13	1.592	0.024	3.03	1.641	0.025	3.232	1.600
CO	17.09	3.346	0.050	33.64	18.214	0.273	21.560	10.672
VOC [c]	4.83	0.946	0.014	1.84	0.996	0.015	1.942	0.961
SO2	0.32	0.063	0.001	0.21	0.116	0.002	0.179	0.089

a AP-42 Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons.
d Assumes the maximum development rate

Buys & Associates, Inc. Environmental Consultants	Project: Encana - Figure 4 Field Development EA

Completion Related Vehicle Tailpipe Emissions

Assumptions:

Average Round Trip Distance	24.0	miles (Estimated from project area and existing road system)
Days of Operation	10	days (Proponent)
nber of Heavy Diesel Truck Trips	79	(Estimated from project description)
Number of Pickup Trips	104	(Estimated from project description)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
eavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
eavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)
Well Development Rate	33	wells per year

Equations:

For NOx, CO and VOC:

$$\text{nissions (tons/year)} = \frac{\text{Emission Factor (g/mile) * \# Trips * Trip Distance (miles)}}{\text{453.6 (g/lb) * 2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{O2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal) * 453.6 (g/lb) * Fuel Sulfur Content * 2 (S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Drilling Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [d]	
	E. Factor [a]	Emissions	Emissions	E. Factor [b]	Emissions	Emissions	Emissions	Emissions
	(g/mile)	(lb/day)	tons/yr/wel	(g/mile)	(lb/day)	tons/yr/wel	(lb/day)	(tons/yr)
NOx	8.13	3.398	0.017	3.03	1.667	0.008	5.066	0.836
CO	17.09	7.143	0.036	33.64	18.511	0.093	25.654	4.233
VOC [c]	4.83	2.019	0.010	1.84	1.012	0.005	3.031	0.500
SO2	0.32	0.134	0.001	0.21	0.118	0.001	0.252	0.042

a AP-42 Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons.
d Assumes the maximum development rate

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Project: Encana - Figure 4 Field Development EA

Construction Related Heavy Equipment Tailpipe Emissions

Assumptions:

Hours of Operation	80	hours/site (10 days @ 8 hrs/day - Specified by Proponent)
Days of Operation	10	Specified by Proponent)
Development Rate	55	pads per year
Load Factor	0.4	(Assumed typical value)
Backhoe Size	100	hp (Assumed Typical value)
Dozer Size	150	hp (Assumed Typical value)
Motor Grader Size	135	hp (Assumed Typical value)

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/hp-hr)} * \text{Rated Horsepower (hp)} * \text{Operating Hours (hrs)} * \text{Load Factor (Dimensionless)}}{453.6\ \text{(g/lb)} * 2000\ \text{(lb/tons)}}$$

Heavy Const.		Backhoe			Dozer			Grader		Total	
Vehicles	E. Factor [a]	Emissions	Emissions[e]	E. Factor [a]	Emissions	Emissions[e]	E. Factor [b]	Emissions	Emissions[e]	Emissions	Emissions
	(g/hp-hr)	(lb/day/pad)	(tons/yr/pad)	(g/hp-hr)	(lb/day/pad)	(tons/yr/pad)	(g/hp-hr)	(lb/day/pad)	(tons/yr/pad)	(lb/day)	(tons/yr)
NOx	8.15	5.750	0.029	8.15	8.624	0.043	7.14	6.800	0.034	21.174	5.823
CO	2.28	0.201	0.001	2.28	2.413	0.012	1.54	1.467	0.007	4.080	1.122
VOC [c]	0.37	0.033	0.000	0.37	0.392	0.002	0.36	0.343	0.002	0.767	0.211
PM10 [d]	0.5	0.044	0.000	0.5	0.529	0.003	0.63	0.600	0.003	1.173	0.323
PM2.5 [d]	0.5	0.044	0.000	0.5	0.529	0.003	0.63	0.600	0.003	1.173	0.323
SO2	0.22	0.019	0.000	0.22	0.233	0.001	0.22	0.210	0.001	0.462	0.127
Formaldehyde	0.22	0.019	0.000	0.22	0.233	0.001	0.12	0.114	0.001	0.366	0.101

a AP-42 Volume II, Mobile Sources, Nonroad Vehicles, Table 11-7.1 Off-highway truck
b AP-42 Volume II, Mobile Sources, Nonroad Vehicles, Table 11-7.1 Motor Grader
c Emission Factor represents total Hydrocarbon Emissions
d All emitted particulate matter assumed to be PM2.5
e Assumes the maximum development rate

Buys & Associates, Inc. Environmental Consultants	Project: Encana - Figure 4 Field Development EA

Drill Rig Engine Emissions

Assumptions:

Hours of Operation 720 hours/well (30 days @ 24 hrs/day - Specified by Proponent)

Development Rate 33 wells/year

Load Factor 0.4 (Typical value)

Rig Size 3200 hp (Proponent)

Diesel Fuel Sulfur Content 0.05 % (Typical value)

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (lb/hp-hr) * Rated Horsepower (hp)* Operating Hours (hrs) * Load Factor (Dimensionless)}}{\text{2000 (lb/tons)}}$$

SO2 E. Factor (lb/hp-hr) = Fuel sulfur content * 0.00809

Species	Drill Rig Emissions		
	E. Factor [a] (lb/hp-hr)	Emissions (lb/hr)	Emissions [e] (tons/yr)
NOx	0.024	30.720	364.954
CO	0.0055	7.040	83.635
VOC [b]	0.000705	0.902	10.721
PM10 [c]	0.000573	0.733	8.713
PM2.5 [d]	0.000479	0.613	7.284
SO2	0.0004045	0.518	6.151

a AP-42 Volume I, Large Stationary Diesel Engines Table 3.4-1, 10/96
b Emission Factor represents total Hydrocarbon Emissions
c Total particulate emission factor is 0.0007, PM10 fraction determined from Table 3.4-2
d Total particulate emission factor is 0.0007, PM2.5 fraction determined from Table 3.4-2
e Assumes the maximum development rate

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Average Produced Gas Characteristics

Gas Heat Value (wet): 1078.0592 Btu/scf

C1-C2 Wt. Fraction:	0.8690
VOC Wt. Fraction:	0.0816
Non-HC Wt. Fraction:	0.0493
Total:	1.0000

COMPONENT	MOLE PERCENT	COMPONENT MOLE WEIGHT (lb/lb-mole)	NET MOLE WEIGHT (lb/lb-mole)	WEIGHT FRACTION	GROSS HEATING VALUE (BTU/scf)	NET DRY HEATING VALUE (BTU/scf)	LOWER HEATING VALUE (BTU/scf)	NET LOW HEATING VALUE (BTU/scf)
Methane	88.1453	16.043	14.141	0.759	1010.000	890.268	910.000	802.122
Ethane	6.7933	30.070	2.043	0.110	1769.800	120.228	1618.000	109.916
Propane	1.8421	44.097	0.812	0.044	2516.200	46.351	2316.000	42.663
i-Butane	0.4337	58.123	0.252	0.014	3252.100	14.104	3005.000	13.033
n-Butane	0.3390	58.123	0.197	0.011	3262.400	11.060	3013.000	10.214
i-Pentane	0.1328	72.150	0.096	0.005	4000.900	5.313	3698.000	4.911
n-Pentane	0.0799	72.150	0.058	0.003	4008.800	3.203	3708.000	2.963
Hexanes+	0.0433	86.177	0.037	0.002	4756.200	2.059	4404.000	1.907
Heptanes	0.0415	100.204	0.042	0.002	5502.500	2.284	5100.000	2.117
Octanes	0.0016	114.231	0.002	0.000	6249.100	0.100		0.000
Nonanes	0.0009	128.258	0.001	0.000	6996.400	0.063		0.000
Decanes	0.0000	142.285	0.000	0.000	7743.200	0.000		0.000
Benzene	0.0047	78.120	0.004	0.000	3715.500	0.175		0.000
Toluene	0.0020	92.130	0.002	0.000	4444.600	0.089		0.000
Ethylbenzene	0.0000	106.160	0.000	0.000	5191.500	0.000		0.000
Xylenes	0.0005	106.160	0.001	0.000	5183.500	0.026		0.000
n-Hexane	0.0196	86.177	0.017	0.001	4756.200	0.932		0.000
Helium	0.0000	4.003	0.000	0.000	0.000	0.000	0.000	0.000
Nitrogen	0.0929	28.013	0.026	0.001	0.000	0.000	0.000	0.000
Carbon Dioxide	2.0289	44.010	0.893	0.048	0.000	0.000	0.000	0.000
Oxygen	0.0000	32.000	0.000	0.000	0.000	0.000	0.000	0.000
Hydrogen Sulfide	0.0000	34.080	0.000	0.000	637.100	0.000	588.000	0.000
TOTAL	100.0020		18.623	1.000		1096.254		989.845

Gas Samples collected from North Chapita 43-31 and 23-31 wells.
HAP fractions estimated utilizing GRI published factors

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Completion Flare Emissions

Assumptions

Hours of Operation	2	days (Typical)
Amount of Gas Flared	0.27	MMscf/day/well (Reported by Project Proponents)
Average Gas Heat Content	990	Btu/scf (Gas Analyses from Existing Wells)
Average Gas VOC Content	8	weight % (Gas Analyses from Existing Wells)
Average Mole Weight	18.6	lb/lb-mole (Gas analyses from Existing Wells)
Development rate	33	wells per year

Equations

NOx/CO Emissions (lb/well) = Emission Factor (lb/MM Btu) * Gas Amount (MMscf/well) * Heat Content (Btu/scf)

PM/HAP Emissions (lb/well) = Emission Factor (lb/MMscf) * Gas Amount (MMscf/well)

$$\text{Flare Gas Wt. (lb/well)} = \frac{\text{Flare Gas Volume (MMscf/well)} * 10^6 \text{ (scf/MMscf)} * \text{Mole Weight (lb/lb-mole)}}{379.49 \text{ (scf/mole)}}$$

VOC Emissions (lb/well) = Flare Gas Wt. (lb/well) * VOC wt. % * 0.02 (Assumes 98% destruction Efficiency)

	Emission Factor (lb/MMBtu)	Well Emissions (lb/well)	Well Emissions (lb/hr/well)	Total Emissions [e] (tons/yr)
NOx [a]	0.068	18.2	0.38	0.30
CO [a]	0.37	98.9	2.06	1.63
VOC	N.A.	21.6	0.45	0.36
SOx [b]	0.00	0.0	0.00	0.00

	Emission Factor (lb/MMscf)	Well Emissions (lb/well)	Well Emissions (lb/hr/well)	Total Emissions [e] (tons/yr)
TSP [c]	7.6	2.052	0.043	0.034
PM10 [c]	7.6	2.052	0.043	0.034
PM2.5 [c]	7.6	2.052	0.043	0.034
Benzene [d]	0.0021	0.000567	0.000	0.000
Toluene [d]	0.0034	0.000918	0.000	0.000
Hexane [d]	1.8	0.486	0.010	0.008
Formaldehyde [d]	0.075	0.02025	0.000	0.000

a AP-42 Table 13.5-1, Emission Factors for Flare Operations, 9/91
b Assumes produced gas contains no sulfur
c AP-42 Table 1.4-2, Emission Factors for Natural Gas Combustion, 3/98 (All Particulates are PM1.0)
d AP-42 Table 1.4-3, Emission Factors for Organic Compounds from Natural Gas Combustion, 3/98
e Assumes the maximum development rate

Production Heater Emissions

Assumptions

Wellsite Separator Size	750	MBTU/hr (Reported by Project Proponents)
Firing Rate	30	minutes/hour on average for entire year (Typical value)
	4380	hours/year
Fuel Gas Heat Content	989	Btu/scf-wet (Gas Analyses from Existing Wells)
Fuel Gas VOC Content	0.0816	by weight (Gas Analyses from Existing Wells)
Development size	332	wells

Equations

Fuel Consumption (MMscf/yr) = Heater Size (MBtu/hr) * 1,000 (Btu/MBtu) * Hours of Operation (hrs/yr)
Fuel Heat Value (Btu/scf) * 1,000,000 (scf/MMscf)

NOx/CO/TOC Emissions (tons/yr) = AP-42 E.Factor (lbs/MMscf) * Fuel Consumption (MMscf/yr) * Fuel heating Value (Btu/scf)
2,000 (lbs/ton) * 1,000 (Btu/scf - Standard Fuel Heating Value)

VOC Emissions (tons/yr) = TOC Emissions (tons/yr) * VOC wt. fraction

	Separator Heater Emissions		
Pollutant	Emission	Well	Total
	Factor	Emissions	Emissions [e]
	(lb/MMscf)	(lb/hr/well)	(tons/yr)
NOx [a]	100	3.792E-02	55.138
CO [a]	21	7.875E-03	11.452
TOC [c]	8	3.000E-03	4.362
VOC	N.A.	2.448E-04	0.356
SOx [b]	0.00	0.000E+00	0.000
TSP [c]	7.6	2.850E-03	4.144
PM10 [c]	7.6	2.850E-03	4.144
PM2.5 [c]	7.6	2.850E-03	4.144
Benzene [d]	0.0021	7.875E-07	0.001
Toluene [d]	0.0034	1.275E-06	0.002
Hexane [d]	1.8	6.750E-04	0.982
Formaldehyde [d]	0.075	2.813E-05	0.041

1.956E-03

a AP-42 Table 1.4-1, Emission Factors for Natural Gas Combustion, 2/98
b Assumes produced gas contains no sulfur
c AP-42 Table 1.4-2, Emission Factors for Natural Gas Combustion, 3/98 (All Particulates are PM1.0)
d AP-42 Table 1.4-3, Emission Factors for Organic Compounds from Natural Gas Combustion, 3/98
e Total heater emissions for project assuming full development of all wells

Buys & Associates, Inc. Environmental Consultants	Project: Encana - Figure 4 Field Development EA

Wellsite Condensate Storage Tank Flash/Working/Standing Emissions

Assumptions:

Average Condensate Production Rate : 4 bbls per day (Average reported by proponents for existing wells)

Size of Development: 332 wells

Calculations:

CDPHE APCD Tank Emissions Memo 12-30-02 re Condensate Storage tanks, Garfield and Rio Blanco Counties

VOC	10	lbs/barrel
Benzene	0.048	lbs/barrel
N-Hexane	0.14	lbs/barrel

Emissions:

Component	Well Emissions (tons/yr/well)	Project Emissions [a] (tons/yr)	per tank (g/s)
Total VOC	7.300	2423.600	
Benzene	0.035	11.633	1.008E-03
n-Hexane	0.102	33.930	2.940E-03
Total HAPS	0.137	45.564	

a Assumes total project development

Production Heater Emissions

Assumptions

Central Dehydrator Reboiler Size	1250	MBTU/hr (Reported by Project Proponents)
Firing Rate	30	minutes/hour on average for entire year (Typical value)
	4380	hours/year
Fuel Gas Heat Content	1078	Btu/scf-wet (Gas Analyses from Existing Wells)
Fuel Gas VOC Content	0.0816	by weight (Gas Analyses from Existing Wells)
Development size	332	wells

Equations

Fuel Consumption (MMscf/yr) = Heater Size (MBtu/hr) * 1,000 (Btu/MBtu) * Hours of Operation (hrs/yr)
Fuel Heat Value (Btu/scf) * 1,000,000 (scf/MMscf)

NOx/CO/TOC Emissions (tons/yr) = AP-42 E.Factor (lbs/MMscf) * Fuel Consumption (MMscf/yr) * Fuel heating Value (Btu/scf)
2,000 (lbs/ton) * 1,000 (Btu/scf - Standard Fuel Heating Value)

VOC Emissions (tons/yr) = TOC Emissions (tons/yr) * VOC wt. fraction

	Reboiler Heater Emissions		
Pollutant	Emission	Reboiler	Total
	Factor	Emissions	Emissions [e]
	(lb/MMscf)	(lb/hr)	(tons/yr)
NOx [a]	100	0.063	0.274
CO [a]	21	0.013	0.057
TOC [c]	8	0.005	0.022
VOC	N.A.	0.208	0.909
SOx [b]	0.00	0.000	0.000
TSP [c]	7.6	0.005	0.021
PM10 [c]	7.6	0.005	0.021
PM2.5 [c]	7.6	0.005	0.021
Benzene [d]	0.0021	0.000	0.000
Toluene [d]	0.0034	0.000	0.000
Hexane [d]	1.8	0.001	0.005
Formaldehyde [d]	0.075	0.000	0.000

a AP-42 Table 1.4-1, Emission Factors for Natural Gas Combustion, 2/98
b Assumes produced gas contains no sulfur
c AP-42 Table 1.4-2, Emission Factors for Natural Gas Combustion, 3/98 (All Particulates are PM1.0)
d AP-42 Table 1.4-3, Emission Factors for Organic Compounds from Natural Gas Combustion, 3/98
e Total heater emissions for project assuming full development of all wells

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Project: Encana - Figure 4 Field Development EA

Central Dehydrator

GRI-GLYCalc VERSION 4.0 - EMISSIONS SUMMARY
Date: February 10, 2004

CONTROLLED REGENERATOR EMISSIONS			
Component	lbs/hr	lbs/day	tons/yr
Methane	0.7689	18.454	3.3678
Ethane	0.5522	13.252	2.4186
Propane	0.6367	15.281	2.7888
Isobutane	0.3509	8.422	1.5371
n-Butane	0.419	10.057	1.8354
Isopentane	0.2297	5.513	1.0061
n-Pentane	0.191	4.583	0.8364
n-Hexane	0.1164	2.793	0.5096
Cyclohexane	0.2788	6.69	1.2209
Other Hexanes	0.1772	4.253	0.7761
Heptanes	0.2724	6.539	1.1933
Methylcyclohexane	0.2845	6.829	1.2463
2,2,4-Trimethylpentane	0.0052	0.126	0.0229
Benzene	1.7834	42.802	7.8113
Toluene	0.9908	23.78	4.3399
Xylenes	0.2576	6.183	1.1284
C8+ Heavies	0.0017	0.041	0.0074
Total Emissions	7.3165	175.597	32.0464
Total Hydrocarbon Emissions	7.3165	175.597	32.0464
Total VOC Emissions	5.9954	143.89	26.26
Total HAP Emissions	3.1534	75.683	13.8121
Total BTEX Emissions	3.0319	72.765	13.2796

Buys & Associates, Inc. Environmental Consultants	Project: Encana - Figure 4 Field Development EA

Gas Compression

Assumptions:

Required Compression: 12,800 Horsepower (Estimated by Project Proponents) BY 2006

Equations:

$$\text{Emissions (lbs/hr)} = \frac{\text{Emission Factor (g/hp-hr)} * \text{Power (hp)}}{453.6 \text{ g/lb}}$$

Pollutant	Emission Factor (g/hp-hr)	Emissions (lb/hr)	Emissions (tons/yr)
NOx [1]	1.0	28.22	123.598
CO [1]	1.0	28.22	123.598
VOC [1]	0.5	14.11	61.799
PM10 [2]	0.022	0.62	2.719
PM2.5 [2]	0.022	0.62	2.719
SO2 [3]	0.0	0.00	0.000
Benzene [2]	0.00180	0.05	0.222
Toluene [2]	0.00064	0.02	0.079
Ethylbenzene [2]	0.00003	0.00	0.004
Xylenes [2]	0.00022	0.01	0.027
Formaldehyde [4]	0.10	2.82	12.360

1 - Average Manufacturer Specified Emission Rate
2 - AP-42 Table 3.2-3 Uncontrolled Emission Factors for 4-Stroke Rich-Burn Engines, 7/00
3 - Fuel gas is assumed to be free from sulfur compounds
4 - GRI published value

Buys & Associates, Inc. **Environmental Consultants**	Project: Encana - Figure 4 Field Development EA

Construction Related Emissions Summary (based on 55 well pads, 22.5 miles road, 33 wells drilled and completed)

Pollutant	Development Emissions (tons/year)			
	Construction	Drilling	Completion	Total
NO_X	5.90	366.55	1.14	373.59
CO	1.49	94.31	5.86	101.66
VOC	0.26	11.68	0.86	12.80
SO_2	0.13	10.81	0.04	10.98
PM_{10}	20.44	301.95	152.70	475.09
$PM_{2.5}$	3.41	52.25	23.41	79.07
Benzene			0.00	0.00
Formaldehyde	0.10		0.00	0.10
Toluene			0.00	0.00
Hexane			0.01	0.01

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Environmental Consultants

Operations Traffic Fugitive Dust Emissions

E (PM10) / VMT = 1.5 * (S/12)^0.9 * (W/3)^0.45 * (365-p)/365
E (PM2.5) / VMT = 0.23 * (S/12)^0.9 + (W/3)^0.45

Silt Content (S)	11		
Round Trip Miles	24	Within Project	25 *
Precipitation Days (P)	88	WRCC Little Hills	

* Each vehicle covers half the Unit in one day

	Vehicle Type	Ave. Weight (lbs)	Round Trips per Day	PM10 (lb/VMT)	Total PM10 (lbs)	PM10 (lb/day)	Total PM2.5 (lbs)	PM2.5 (lb/day)
Operations	365							
	Haul Truck:Condensate	48,000	2					
	Pickup Truck: Crew	7,000	2					
	Mean Weight	27,500	4	2.088335	149399.5	409.3	22907.9	62.8

Total PM10 (tons/year)	Total PM2.5 (tons/year)
74.70	11.45

Buys & Associates, Inc. Environmental Consultants	Project: Encana - Figure 4 Field Development EA

Operations Tailpipe Emissions

Assumptions:

Average Round Trip Distance	49.0	miles (Estimated from Project Area and existing road system)
Days	365	days (Proponent)
Number of Heavy Diesel Truck Trips	2	(Estimated)
Number of Pickup Trips	2	(Estimated)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{453.6\ \text{(g/lb)} * 2000\ \text{(lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * 453.6\ \text{(g/lb)} * \text{Fuel Sulfur Content} * 2\ \text{(S / SO2)}}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [d]	
	E. Factor [a] (g/mile)	Emissions (lb/day)	Emissions (tons/yr/)	E. Factor [b] (g/mile)	Emissions (lb/day)	Emissions tons/yr/wel	Emissions (lb/day)	Emissions (tons/yr)
NOx	8.13	1.756	1.484	3.03	0.655	0.553	2.411	2.037
CO	17.09	0.010	3.119	33.64	7.268	6.139	7.278	9.258
VOC [c]	4.83	0.00286	0.881	1.84	0.398	0.336	0.400	1.217
SO2	0.32	0.00019	0.059	0.21	0.046	0.039	0.046	0.098

a AP-42 Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons.
d Assumes the maximum development rate

Total Project Production Related Emissions Summary

	Total Project Production Related Emissions (tons/year)						Total
Pollutant	Separator	Dehydrator	Condensate	Central	Vehicle	Vehicle	
	Heater	Still Vent	Tank Flash	Compression	Tailpipe	Fugitive Dust	(tons/year)
NO_X	55.138			123.60	2.04		180.77
CO	11.452			123.60	9.26		144.31
VOC	0.356		2423.60	61.80	1.22		2486.97
SO_2	0.000			0.00	0.10		0.10
PM_{10}	4.144			2.72		74.70	81.56
$PM_{2.5}$	4.144			2.72		11.45	18.32
Benzene	0.001	7.81	11.63	0.22			19.67
Toluene	0.002	4.34					4.34
Ethylbenzene							0.00
Xylene		1.13					1.13
n-Hexane	0.982	0.51	33.93				35.42
Formaldehyde	0.041			12.36			12.40

Full Field Development 332 wells

0.035259001

Total Project Annual Emissions Summary (tons/year)

Pollutant	Project Phase Development (tons/year)	Project Phase Production (tons/year)	Maximum Annual (tons/year)
NO_X	373.6	180.8	554.4
CO	101.7	144.3	246.0
VOC	12.8	2487.0	2499.8
SO_2	11.0	0.1	11.1
PM_{10}	475.1	81.6	556.7
$PM_{2.5}$	79.1	18.3	97.4
Benzene	0.0	19.7	19.7
Toluene	0.0	4.3	4.3
Ethylbenzene	0.0	0.0	0.0
Xylene	0.0	1.1	1.1
n-Hexane	0.0	35.4	35.4
Formaldehyde	0.1	12.4	12.5

Stack Parameters				
Equipment	**Temp**	**Velocity**	**Diameter**	**Height**
	(K)	**(m/s)**	**(meters)**	**(meters)**
Compressor	811	35	0.3048	9.1
Drill Rig	800	50	0.1	7.6
Boiler	700	1.6	0.3048	4.6
Tank	366	0.01	0.05	6.7
assumes 20-ft high tank with horizontal exhaust				
TEG Dehydrator	366	0.001	0.05	3.65

Appendix E

APPENDIX E - PUBLIC COMMENTS ON THE DRAFT ENVIRONMENTAL ASSESSMENT AND BLM'S RESPONSES

Introduction

The public comment period for the Figure Four Natural Gas Project Environmental Assessment was from July 30 to September 3, 2004. A total of five comment letters were received, of which three were by electronic mail. Copies of these comment letters are available upon request from the White River Field Office. Every comment letter was read and the comments identified. The appropriate Interdisciplinary Team member was then assigned the comments relating to their specialty in order to develop a response. All public comments and BLM's responses are presented in the table below.

Number	Comment	Response
Comment Letter 1 – Western Colorado Congress		
1-1	We believe that the White River Field Office should select the No Action alternative	Comment noted. The No Action Alternative has been analyzed in the Environmental Assessment (EA) and has been given due consideration.
1-2	Our greatest concern is the cumulative environmental impacts of this proposal, and those associated with the intended expansion of this project and its associated activities throughout the region.	As described in Section 5.0 of the EA, cumulative impacts were addressed for the Proposed Action itself, potential future expansion of the Proposed Action, additional natural gas drilling and production outside of the Figure Four Unit on federal and private locations in the Cumulative Impact Assessment Area (CIAA), and other BLM and private activities such as livestock grazing, road improvements, and recreational activities.
1-3	The cumulative impacts of the region should also be considered for the 30-year lifespan of the projects.	The cumulative impacts assessment in the EA envisioned cumulative impacts over the entire 20 to 30 year timeframe of the Proposed Action.
1-4	We are also concerned about soil stability issues that will be created with this proposal. Due to the topography of the area, the number of major cuts into the ridges and the travel of heavy equipment into the area will likely cause major erosion in the area.	The federally required environmental protection measures listed in Section 2.2.6.3, and the mitigation measures identified in Section 4.3.3 and 4.13.3 would be implemented to minimize erosion and sedimentation associated with project construction.
1-5	This erosion will likely cause significant sedimentation in the creeks and drainages in the project area.	See the response to comment 1-4.
1-6	Finally, we see a great potential for wildlife and recreational conflict due to the over 44 miles of new roads proposed to be created. There is a substantial road network currently in the area, which should be utilized to the greatest extent possible before construction new roads. Research has shown that	After additional review of proposed new and upgraded roads to be used for the project, section 2.2.1.3 of the EA has been revised to indicate that 35.4 miles of existing roads would be utilized for the project and 33.4 miles of new roads would be constructed. Wildlife impacts related to proposed road construction are addressed in Section 4.9. Impacts to recreation related to potential displacement of

Number	Comment	Response
	roads are the primary means of habitat fragmentation, and loss of wildlife had lead to negative environmental, social and economic losses.	wildlife and diminished hunter success are addressed in Section 4.12. BLM encourages the use of existing roads as much as possible. In a few exceptional cases, BLM has recommended construction of new roads to replace existing roads that adversely affect/fragment sensitive wildlife habitat. Impacts associated with new roads would be reduced by the installation of gates to restrict public access on about 70% of the proposed new roads. In addition, the use of remote telemetry would reduce project-related traffic on project-related roads by as much as 75%, as described in sections 2.2.2 and 4.9.3.
1-7	To the greatest extent possible the number of wells drilled on each pad should be maximized. We'd like to see this number increase to at least 5 per pad, and the numbers of total pads decrease to closer to 75.	The proposed distribution of well pads across of the Project Area and number of wells per pad were identified based on the desire to adequately explore the natural gas resources that may be present. Current directional drilling technology in the Piceance Basin is limited to a horizontal reach of about 2,000 feet. Accordingly, the 120 proposed well pad locations were laid out to provide access to the entire Figure Four Unit, bearing in mind this directional drilling limitation. Reduction of the number of well pads would reduce EnCana's ability to exercise their lease rights and reach all of the geologic targets they intend to explore as part of the Proposed Action.
1-8	At least the BLM's recommended pad relocations should be made, as should all of the recommended surface use stipulations.	The Proposed Action has incorporated all of BLM's recommended pad relocations intended to reduce environmental impacts, as described in Section 2.4.1. In addition, the EA assumed all applicable surface use stipulations described in Section 2.2.5 and conditions of approval (COA) would be applied to the Proposed Action, recognizing that in some cases exceptions, modifications, or waivers may be granted.
1-9	Again the best method to eliminate the impacts associated with this project is to select the No Action alternative.	Comment noted. The No Action Alternative has been analyzed in the Environmental Assessment (EA) and has been given due consideration.
1-10	Where will produced water be disposed? If trucked off-site, where will it be treated?	Produced water would either be used for drilling and completion of project wells or disposed of offsite at an existing permitted facility in Rio Blanco County. Produced water will only be used in well completions or in drilling after the surface casing is cemented and any freshwater zones are isolated.
1-11	Encana has purchased some water rights, but they described utilizing some water from the river, creeks and springs in their operations. Have water rights been obtained for all required uses, especially those proposed to be diverted from the White River (pg 2-10)?	As described in Section 2.2.1.6, water for the proposed project would be obtained from a combination of sources. Typically, EnCana would utilize the sources closest to the Figure Four Unit first and rely on more distant sources when closer sources are not available for diversion. EnCana presently holds water rights on Piceance Creek associated with its Stecker Ranch property and a nearby spring

Number	Comment	Response
		and would likely use water from these sources as a first choice. However, during low flow periods in Piceance Creek, when water is only available to holders of more senior water rights, EnCana would likely purchase water from another source in the Piceance Creek Valley with senior water rights. EnCana does not hold water rights on the White River and would only divert water from that source as a last resort and when surplus flow is available.
1-12	Water recycling should be allowed only after it has been tested for surface discharge quality.	Since the water used for drilling and completion won't be discharged on the surface and surface casing would protect shallow groundwater, water quality testing is not required for use of recycled water for well drilling and completion.
1-13	Due to the steep slopes and fine soil, there is a high potential for sedimentation in the creeks and the river due to erosion. Sediment loads should be monitored on a regular basis to ensure downstream water quality.	The mitigation measures identified in the response to comment 1-4, above, would ensure that sedimentation is minimized. In addition, most of the project drainages are ephemeral and flow only after storm events. Therefore, sedimentation would occur only during these runoff events.
1-14	Major efforts should be made to stabilize the soils once they have been disturbed, including ground netting and concurrent reclamation.	See the response to comment 1-4.
1-15	Steep slopes and major cuts should be avoided to prevent major slides during rain and snowstorms.	Detailed design drawings would be submitted for each well pad prior to construction. The design of each pad would include measures to avoid the creation of unstable slopes, where called for in the various lease and surface stipulations (refer to Sections 2.2.6.3 and 4.3.3).
1-16	Poor soils are conducive to noxious weed invasion. Regular monitoring of revegetation efforts should occur to insure that grazing by domestic and wild animals is not impacted and that the local agricultural and hunting operations are not adversely impacted.	EnCana would be subject to numerous COAs identified by BLM to minimize the potential for noxious weed invasion and establishment in the Project Area. These COAs will include the measures described in Sections 4.8.1.3 and 4.8.3.3 of the EA, including monitoring on an annual basis (or as determined by the Authorized Officer) throughout the 20 to 30 year life of the project.
1-17	6 compressors are outlined in the project, but very few are located on maps. One compressor is known to be in close proximity to a residence. Noise near residences should be kept to state standards and noise mitigation measures should be utilized to the maximum extent to prevent disturbances.	As described in Section 2.2.1.5, all six of the compressor engines would be located in the two compressor stations identified on Figure 2-2. Section 4.7.1.2 addresses noise that would be generated by project-related compressor stations, potential effects on the one residence in the area, and noise standards that would apply.
1-18	County Road 69 should be utilized in the project to minimize the need for new roads.	As described in Section 2.2.1.3, County Road 69 and the existing Hunter Creek Road would serve as the main access routes into the Figure Four Project Area.
1-19	A 50% increase in roads in the area will adversely impact wildlife and increase Off-Road Vehicle trespassing in the	In an effort to reduce new surface disturbance and minimize the construction of new roads (and avoid associated costs), EnCana would utilize existing roads as

Number	Comment	Response
	project area. Existing roads should be utilized to the greatest extent possible and new road construction should be kept to only those necessary.	much as possible.
1-20	How will the safety of hunters and gas project workers be ensured during the hunting season? All hunting should be prohibited in the project influence area during the hunting seasons.	As stated in Section 4.12 – Recreation, project-related construction of well pads, roads, and pipelines, and the drilling and completion of natural gas wells would generate vehicle traffic, noise, and general human activity. Since hunters generally prefer relatively quiet settings, it is likely that hunters would avoid active construction areas and well drilling activities and safety would not be a problem. However, to ensure the safety of hunters and project workers alike, warning signs would be posted on Project Area roads in the vicinity of active well sites that construction activity is taking place.
1-21	All production activities should be kept from the Sage-grouse lek areas, and a mile buffer should be respected to protect nesting sites. Well pad should be concentrated away from the breeding and nesting areas.	The closest known sage-grouse lek occurs 0.8 miles from the Figure Four Project Area boundary, and no proposed well pad locations would occur within 1 mile of known leks. In addition, mitigation described in Sect. 4.9.4.3 would not allow ground disturbing activities to occur in potential sage-grouse nesting and brooding habitat (Sect. 7, 19-20, 26-29, 34-35) during the nesting season (March 1 to July 15). With these mitigation measures, no ground disturbing activities would occur within 2 miles of a known lek during the breeding season.
1-22	Elk and Mule deer populations should be counted and monitored annually for signs of decreased productivity. If it is shown to be in decline all activity should be stopped on the project until it returns to normal levels.	Elk and mule deer populations can be influenced by a wide variety of factors, many of which would have nothing to do with the Proposed Action. Examples include winter severity, summer drought conditions, variations in predation, hunting pressure, and disease outbreaks (e.g., CWD). In Colorado overall and in the White River Resource Area, mule deer populations have been declining for years. Even if big game population monitoring were implemented, the BLM would need many years of data in all seasons to statistically prove that the Project was the cause of declines.
1-23	Who will conduct the regular monitoring and inspections of the operations?	Inspections of all project-related facilities would be carried out by EnCana on a regular basis both to verify facilities are in proper working order and to identify problems, such as hydrocarbon or produced water leaks, weed infestations, revegetation progress, erosion problems, etc. The company would typically visit all well sites at least once per week. In addition, the BLM would perform inspections of the Project Area in accordance with 43 CFR Part 3160, Onshore Oil and Gas Operations to verify compliance with various lease stipulations, conditions of approval, and other mitigation measures described in the EA.

Number	Comment	Response
1-24	Regular water quality testing should be conducted on site and at regular increments down the drainages into the White River. These should be funded by Encana, and executed by an independent contractor to the BLM.	Regular water quality testing is currently performed by the USGS at two gaging stations located on Piceance Creek downstream from the Project Area and on the White River near Boise Creek. In addition, most of the Project Area drainages are ephemeral and flow only after storm events.
1-25	Additional wells should not be approved unless the current proposal has shown to have a good record of operation with the BLM and the COGCC. If there are outstanding fines or violations with EnCana, no further activity should be allowed until matters are resolved.	Approval of additional federal wells in the Figure Four Unit would require a separate NEPA analysis. Comment noted.
1-26	The EA fails to assess in detail or quantify the impacts of this development on the recreation industry in Rio Blanco and Garfield Counties. How much money is currently spent on recreation and tourism related activities in Rio Blanco County? Will this amount be decreased by the Figure Four development and if so by how much?	The Colorado Division of Wildlife's study entitled "Economic Impact of Hunting, Fishing, and Wildlife Watching in Colorado" was obtained. According to that study, in Rio Blanco County, total direct sales associated with wildlife-related activities was approximately $16.3 million in 2002. The total economic impact to the county, including secondary spending by people who own or work for businesses related to wildlife activities was about $28.4 million. Wildlife-related activities were responsible for approximately 360 jobs. In Garfield County, the study estimated total direct sales related to wildlife activities to be approximately $30 million, the total economic impact was about $53.1 million, and employment related to wildlife activities to be about 690 jobs. It is important to note that about 54% of these impacts were related to fishing. Given the lack of opportunities for fishing in and around the Project Area and Piceance Creek Valley, there would be no impact to fishing-related economic activity in either county. Furthermore, given the relatively small size of the Figure Four Project Area (0.44% of the land area of the two counties) and its relative inaccessibility, compared to the abundant quantity of more accessible public lands available elsewhere in the counties, it is unlikely that wildlife-related activities and their economic benefits would be substantially reduced by the Proposed Action.
1-27	What percentage of sales tax revenue in each county is generated by tourism, fishing, hunting and other recreational activities? According to section 3.15.2 of the EA, since 1990 the economies of the two counties have diversified and grown steadily because of increased real estate, resort, tourist and recreational activity. Will this diversification trend be impacted by gas development? Will sales tax revenues in	Given the confidential nature of private business revenue and taxes paid, it is difficult to identify the percentage of sales tax revenue that is generated specifically by tourism and recreation in Rio Blanco County. Businesses that provide lodging, restaurant meals, gasoline, sporting goods, and other goods and services serve a broad array of customers and it is therefore difficult to gage the percentage of revenues and sales taxes that is generated by tourists and recreational visitors versus other local and non-local business activity not related

Number	Comment	Response
	Rio Blanco County be decreased due to the Figure Four development?	to recreation. With respect to economic diversification of the two counties, the Figure Four Project Area is in such a remote location that it is unlikely that other economic sectors, such as real estate and resort visitation would be affected at all. As stated previously, the abundance of alternative areas for recreational activities make it unlikely that the impacts to hunting in the Project Area would affect the overall tourist and recreation industry in the two counties, or decrease sales tax revenue. Sales and use taxes that would be paid by EnCana and its contractors as a result of the Proposed Action would likely increase total county revenue and offset any reduction in recreation-related sales tax revenue.
1-28	The EA does not assess the potential economic harm to grazing lessees. In most cases, the acreage disturbed for well pads, access roads, compressor stations and other facilities reduces the carrying capacity of the permit. What will be the direct costs to grazing permittees due to reduced allotment AUM's and death loss due to improperly fenced reserve pits and collisions with well field traffic? These losses are fairly high in the Farmington Field Office region in New Mexico. Who will compensate the livestock owners for these losses?	Specific impacts to grazing allotments in the Figure Four Project Area have been calculated. In the Piceance Mountain Allotment, the construction of 82 well pads and related roads and other infrastructure would result in the long-term loss of about 35 animal unit months (AUMs) out of 3,807 AUMs. In the Fawn Creek Allotment, the construction of 38 well pads and related roads and other infrastructure would result in the long-term loss of about 19 AUMs out of 1749 AUMs. This information has been added to Section 4.8.1.4 of the EA. Since reserve pits would be properly fenced to exclude livestock, no losses are anticipated due to pits. Collisions between livestock and project vehicles are possible, but the incidence of livestock injury and death is expected to be very low. Compensation of livestock owners would have to be negotiated on a case-by-case basis, depending on the circumstances involved and the parties at fault.
1-29	How does the project impact the counties' costs of providing local services? The EA merely lists the law enforcement services provided by each county. There are no detailed projections of impacts to county services. Will more law enforcement officers be needed during field development? Will more medical services need to be provided? Will more nurses need to be hired?	According to the Rio Blanco Sheriff's Department, all law enforcement calls from the Figure Four Project Area would be handled by their office, since there is no roaded access from Garfield County and response time would be prohibitively long from Garfield County. The Sheriff's Department has experienced an increase in calls and complaints in recent years due to natural gas-related traffic and trucking. In response, the Department has requested additional funding from the Rio Blanco County Commissioners for an additional deputy and patrol car to handle the additional demand for law enforcement services and patrols on County Road 5. The Sheriff's Department has requested a budget increase of about $85,000 to cover this cost. The added cost in subsequent years would be about $50,000 annually. Medical emergencies are generally uncommon in the gas industry and the medical facilities available in Meeker and Rifle are more than adequate to accommodate additional potential emergencies associated with the

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		Proposed Action. In general, EnCana has indicated they would drive workers with minor injuries to Meeker or Rifle. In the case of a serious medical emergency, Flight for Life would be summoned from St. Mary's Hospital in Grand Junction.
1-30	How will the increased traffic impact road and bridge maintenance for the two counties? Will they need more maintenance equipment? Will the frequency of road repair increase? Will there be an increased demand for solid waste disposal?	For all gravel or dirt surfaced county roads serving the Project Area, EnCana has entered into an agreement with the Rio Blanco County Road and Bridge Department to maintain and improve those county roads as needed at the company's expense (blading, graveling, etc.). As a result, a substantial portion of the road maintenance burden associated with the proposed project would be borne by EnCana, rather than the county. The paved portions of County Road 26 and County Road 5 would still be maintained by the county, however. Discussions with the Rio Blanco County Road and Bridge Department regarding County Roads 5 and 26 did not reveal specific costs associated with County road work that may be required as a result of the Project. However, the project would pay applicable property, sales, and use tax for all of its natural gas wells and related infrastructure in Rio Blanco County, which should offset increased costs experienced by the County Road and Bridge Department. There are no Garfield County roads that serve the Figure Four Project Area. The Rio Blanco County landfill has adequate capacity to hold solid waste that would be generated by the Proposed Action. Solid waste would be hauled by a contractor/waste collection service to the county landfill and the applicable disposal fees paid.
1-31	An increasingly noticeable problem associated with gas development is its impacts on human health. Ozone affects lung tissue in humans and can severely affect people with asthma. How will residents of Rio Blanco and Garfield counties be impacted by ground level ozone? What will be the increased costs of health care as a result of this development?	The comment that gas development has increasingly impacted human health is conjecture. Under the Clean Air Act, National Ambient Air Quality Standards (NAAQS) have been promulgated for the purpose of protecting human health and welfare with an adequate margin of safety. The State of Colorado has adopted the NAAQS with a modification for sulfur dioxide (SO_2). All of Rio Blanco and Garfield Counties have been designated as attainment areas, meaning that the concentration of all criteria pollutants, including ground-level ozone, are less than the NAAQS. This conclusion is based upon the judgment of the State of Colorado. As described in Sections 4.6 and 5.6, review of likely project emissions concluded that the Proposed Action individually and cumulatively would not contribute to any exceedances of applicable air quality standards. Since none of the NAAQS would be exceeded, there would be little or no adverse impacts on human health from ground-level ozone and no increased health care costs are anticipated.

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1-32	This analysis fails to provide specific information on costs to local governments and citizens and therefore fails to meet a major requirement of the NEPA process.	Apart from law enforcement services described in response 1-29, discussions with local government service providers did not yield specific costs associated with county services that could be attributed to the Proposed Action itself. However, discussions with the Rio Blanco County Assessor's Office and Sales and Use Tax Office indicated that substantial additional tax revenues are anticipated from the proposed project and that these additional revenues would likely offset the increased costs associated with increased demand for county services.
1-33	This EA needs to have a specific enforcement plan attached as part of the Decision Record. In short, the plan should be very comprehensive and provide a method of tracking the annual number of inspections, violations, and remedial actions taken. It should provide a road map delineating the success of the enforcement or monitoring effort put forth by the White River BLM office.	See response 1-23.
Comment Letter 2 – Colorado Environmental Coalition, Grand Valley Citizens' Alliance, Center for Native Ecosystems, The Wilderness Society		
2-1	We believe that the WRFO should withdraw this EA and proceed with this project only after it has updated its analysis to more accurately consider the scope and nature of this project, especially in conjunction with other related and similar, activity throughout the region, both inside and outside the lands administered by the WRFO.	The Figure Four EA accurately considered the full scope and nature of the proposed project. BLM devoted considerable time in meeting with EnCana and in the field to fully consider and understand the project in its entirety. The EA also considered a wide array of other projects and activities on public and private lands throughout the region in its assessment of cumulative impacts.
2-2	Our greatest concern is the cumulative impacts of this proposal, and those associated with the intended expansion of this project and associated, connected and related activities throughout the region.	All connected actions, such as the proposed Hunter Creek pipeline and compressor stations in the Hunter Creek Valley were added to and incorporated into the EA as part of the Proposed Action. The cumulative impacts analysis included the Proposed Action, plus potential future expansion of the Proposed Action, additional natural gas drilling and production outside of the Figure Four Unit on federal and private locations in the CIAA, and other BLM and private activities such as livestock grazing, road improvements, and recreational activities.
2-3	We see a great potential for wildlife and recreational conflict due to the over 44 miles of new roads proposed to be created. There is a substantial road network currently in the area, which should be utilized to the greatest extent possible before construction new roads. Research has shown that roads are the primary means of habitat fragmentation, and	See response to comment 1-6.

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	loss of wildlife had lead to negative environmental, social and economic losses.	
2-4	To the greatest extent possible the number of wells drilled on each pad should be maximized. Under the current proposal, only 3 wells will be drilled per pad. We believe that the BLM should include additional alternatives in its analysis that includes stronger protections, requires the use of Best Management Practices (BMPs) and more wells per pad with less new pads constructed.	See response to comment 1-7. The Proposed Action presented in the EA incorporated lease terms, stipulations, and mitigation measures intended to provide protection of all resource values consistent with the White River Resource Management Plan and other legal requirements. The array of mitigation measures developed by BLM for the Proposed Action includes implementation of Best Management Practices (BMPs). Finally, with the use of directional drilling, the Proposed Action has reduced the number of pads that would otherwise be required by about 63% (327 wells on 120 pads).
2-5	The BLM should seriously consider an EIS for this project. The shear size of the EA (weighing in at lbs.) suggests that more in depth analysis is appropriate. Where a proposal is so complex that a concise document cannot meet the goals of [NEPA] Section 1508.9 and where it is extremely difficult to determine whether the proposal could have significant environmental effects. Of course it is not the number of pages or weight of an environmental document that determines if an EIS is needed; rather, it is the level of development proposed by this project, especially combined with the scale of energy development throughout this region of the West, much of it under land use plans pushing twenty years, that suggests additional cumulative and 'big picture' analysis is warranted.	The size of the EA is due to the complexity of the project proposed, the resource issues identified, and the need for an in-depth analysis to accurately evaluate the potential for significant environmental effects. In order to make an informed decision, a brief and concise review was not considered sufficient, particularly given the current level of public controversy surrounding natural gas projects on public lands. The current Resource Management Plan (RMP) and associated EIS were completed for the White River Resource Area in 1997. The 1997 RMP addressed all reasonably foreseeable oil and gas development over a 20-year period, which included 1,154 oil and/or gas wells, with a total surface disturbance of 11,540 acres including all related infrastructure, such as roads and pipelines. The specific development proposed for the Figure Four Project as well as cumulative impacts to the Resource Area are within the scope and analysis of that previous RMP/EIS.
2-6	With a project of this scale, and with future development of similar magnitude reasonably foreseeable, the impacts of long-range transportation facilities associated with this development should have been addressed or at least cross-referenced in this Environmental Assessment (EA). While this EA does address some of the impacts of the 20-inch main gas gathering line through the Hunter Creek Valley, this is not the end of the transmission for gas extracted from the Figure Four unit.	The Figure Four EA assumed that produced natural gas would be piped down the Hunter Creek Valley to a sales point on the existing Colorado Interstate Gas (CIG) transmission pipeline. Given the regional transmission of project-related gas was assumed to occur in an existing pipeline, the analysis of environmental effects stopped at the point of delivery at that pipeline.
2-7	Given the concurrent investment by the operator (EnCana)	Other regional transmission infrastructure has been planned, regardless of whether

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	into major regional infrastructure, this project should clearly be considered as a "connected" action with this other, related development.	the Proposed Action is implemented or not and would connect various other gas producing areas with interstate pipeline infrastructure. Since regional pipeline projects would be built independent and regardless of the Proposed Action, they are not connected actions and are outside the scope of the Figure Four EA. Since it was assumed the Figure Four Project would utilize the existing CIG pipeline for transmission, the Figure Four Project is not a connected action of the regional pipeline project. Connected actions are those that are "closely related" to the proposal and alternatives. Connected actions automatically trigger other actions, they cannot or will not proceed unless other actions have been taken previously or simultaneously, or they are interdependent parts of a larger action and depend on the larger action for their justification (40 CFR 1508.25).
2-8	The Council on Environmental Quality's regulations require that federal agencies consider "connected actions" and "cumulative actions" together with "direct" and "indirect" impacts (40 CFR § 1508.25). These environmental analysis requirements should apply to both the road access permit application as well as any of the "connected" development of the private in-holding.	The EA evaluated all well pad, road, pipelines, and ancillary facilities (connected actions) on public and private lands as part of the Proposed Action. For cumulative actions, a variety of off-site oil and gas development was considered; including pipelines and roads (Refer to Section 5.0 of the EA).
2-9	Because the need for expanded transmission is tied to a purported increase in development, and because the same company is proposing both a major increase in gas production and an expanded transmission pipeline into Wyoming, it seems disingenuous that the full impact of associated development directly related to this project is not even mentioned in this EA.	As stated in the response to comment 2-7, the regional transmission pipeline referenced in the comment would be built to serve numerous producing areas and would be built independent and regardless of whether the Figure Four Project were implemented or not. The Figure Four Project and the regional pipeline are independent projects.
2-10	Unfortunately, the BLM uses this single NEPA document covering approximately 327 wells, without including any provisions for adaptive management and monitoring through the life of this project. This EA should encompass adaptive monitoring at the outset where the consequences of drilling over 300 wells during over an estimated four-year period will proceed with both time for monitoring and time to begin measuring the cumulative impacts as development expands.	As described in the response to comment 1-33, the BLM would conduct routine inspections of the Figure Four Project Area as part of its Inspection & Enforcement (I & E) strategy for natural gas projects in the White River Field Office area. Application of the I & E process to the Figure Four Project would assure that required mitigation measures and conditions of approval are complied with by EnCana and its contractors or enforcement actions would be taken. All lease stipulations and other mitigation measures would be enforced throughout the life of the project.
2-11	We also note that relying on EnCana, or its subcontractors, to	See response to comment 1-23. Under the Mineral Lease Act and its

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	"immediately report" (EA at 2-11) spills and mishaps to the BLM is problematic. Additional monitoring and bonding requirements seem appropriate given the history of the operator in the area.	implementing regulations, oil and gas lessees/operators must furnish bonds to BLM to ensure compliance with all the lease terms, including protection of the environment on federal surfaces. EnCana has furnished BLM with a nation-wide bond that applies to oil and gas activities on lease.
2-12	Water quality standards are typically composed of numeric standards, narrative standards, designated uses, and an antidegradation policy. All too often, as in this EA, only the numeric standards are included as standards when addressing the affected environment.	Section 3.4.2 has been revised to include discussion of the narrative standards, designated uses, and antidegradation policy applicable to Piceance Creek and its tributaries.
2-13	This EA should provide for how designated uses will be achieved, including recreational and agricultural uses, and if they are not, require prompt management changes even if numeric standards are otherwise being met. These narrative provisions and designated uses of the Colorado Water Quality Standards must be met, although this EA makes no mention of how these uses will be impacted in this EA.	Mitigation measures have been designed for this project that are protective of surface water quality and would contribute to the attainment of all surface water quality standards, goals, and designated uses. However, the ultimate attainment of designated uses and narrative provisions for Piceance Creek and its tributaries is influenced by a wide range of private and BLM-authorized activities in the area, including irrigated agriculture, livestock grazing, sodium mineral extraction, and other current uses not related to the Proposed Action. A discussion of potential impacts to recreational and agricultural uses of surface water within the Project Area has been added to Section 4.4.1.
2-14	The EA states that direct impact to big game habitat (elk and mule deer) would result in habitat loss of 4,353 acres - nearly a quarter of the proposed project area. With the associated roads, habitat fragmentation, increased traffic and loss of habitat and elk due to overall avoidance, we feel that significance of this impact is not only one of biology, but should have been greater attention in the socio-economic section of this EA.	Section 4.15.1.2, under Socioeconomics, has been revised to include a discussion of the overall role of hunting and recreation in the local economies of Rio Blanco and Garfield Counties.
2-15	In addition, wildlife-related socioeconomic impacts to local communities are broader than the direct impacts to individual outfitting permitees. Permitting and guiding on private lands, unguided hunts on public lands and wildlife watching are significant sources of income for local communities in northwestern Colorado.	See response to comment 1-26.
2-16	There are three known leks located within two miles of the project area boundary (EA at 4-32); however, this EA does	See response to comment 1-21.

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	not address the impact to leks in close proximity to development on this scale could affect those known leks. While this EA does estimate the acreage of direct habitat loss (878.2 acres) and potentially degraded habitat (2822.8 acres) within the project area, this EA should more thoroughly address the impacts to sage grouse, especially leks and lek complexes that are known to exist in potentially critically close proximity to the project area.	
2-17	The EA fails to assess in detail or quantify the impacts of this development on the recreation industry in Rio Blanco and Garfield Counties. How much money is currently spent on recreation and tourism related activities in Rio Blanco county? Will this amount be decreased by the Figure Four development and if so by how much? What percentage of sales tax revenue in each county is generated by tourism, fishing, hunting and other recreational activities?	See response to comment 1-26.
2-18	According to section 3.15.2 of the EA, since 1990 the economies of the two counties have diversified and grown steadily because of increased real estate, resort, tourist and recreational activity. Will this diversification trend be impacted by gas development? Will sales tax revenues in Rio Blanco county be decreased due to the Figure Four development?	See response to comment 1-27.
2-19	How does the project impact the counties' costs of providing local services? The EA merely lists the law enforcement services provided by each county. There are no detailed projections of impacts to county services. Will more law enforcement officers be needed during field development? Will more medical services need to be provided? Will more nurses need to be hired?	See response to comment 1-29.
2-20	How will the increased traffic impact road and bridge maintenance for the two counties? Will they need more maintenance equipment? Will the frequency of road repair increase? Will there be an increased demand for solid waste	See response to comment 1-30.

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	disposal?	
2-21	An increasingly noticeable problem associated with gas development is its impacts on human health. How will residents of Rio Blanco and Garfield counties be impacted by ground level ozone? What will be the increased costs of health care as a result of this development?	See response to comment 1-31.
2-22	This analysis fails to provide specific information on costs to local governments and citizens and therefore fails to meet a major requirement of the NEPA process.	See response to comment 1-32.
2-23	'Best Management Practices' (BMPs) have improved over the last two decades, and the BLM should describe and seriously consider these technologies in one or more of its alternatives.	The array of mitigation measures developed by BLM for the Proposed Action already includes implementation of Best Management Practices (BMPs) to reduce numerous project-related impacts.
2-24	But while these policy statements sound like an unequivocal commitment to implement low impact techniques, until the BLM actually considers such in its analysis and requires such on the-ground, these statements are no more than empty words. The Department of Interior (DOI) has recently issued guidance to encourage BMPs and cites several examples: • Reducing the "footprint" of roads and well heads by choosing the smallest safe standard and best location for facilities, and by employing interim reclamation. • Selecting appropriate color, shape, size and/or location for facilities to reduce visual contrast. • Discouraging raptor predation on sensitive species by installing perch-avoidance structures or burying power lines on the lease area. • Reducing wildlife disturbance by centralizing or automating production facilities to reduce frequency of travel to each well head. • Using common utility corridors or burying flowlines in a roadway or an adjacent right-of-way.	Many of the BMPs mentioned in the comment are specifically identified in the EA for implementation. Examples include interim reclamation along roads and at well pads (Sections 2.2.1.1 and 2.2.1.3), selection of a natural colors for facilities to reduce visual impacts (Sections 2.2.6.4 and 4.13.3), use of remote telemetry to reduce frequency of travel to wellheads (Sections 2.2.2 and 4.9.3), and use of common utility corridors for gas gathering and water lines within or immediately adjacent to access roads (Sections 2.2, 2.2.1.3, and 2.2.1.4).
2-25	The DOI guidance states that reclamation of disturbed areas, including access roads, should be to either original contours	Section 2.2.4 describes how reclamation of disturbed areas would be carried out, including restoration of original contours, replacement of topsoil, and revegetation

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	or to blend with the topography, and notes that this technique is a practice that planners "should consider in nearly all circumstances."	with a BLM-approved weed-free seed mixture.
2-26	By not including additional alternatives that outline a range of management options and environmental consequences, the BLM is failing to meet the NEPA mandate to present the issues in a comparative fashion. A project of this scale deserves more careful consideration, most likely through an EIS, that adequately considers direct, indirect and cumulative impacts of this and of related and connected actions. A reasonable range of alternatives, including one that incorporates BMPs and includes more wells on each pad (and less new pads and related roads, etc.) seems warranted.	The Figure Four EA addresses direct and indirect impacts of the proposed well field and all connected actions in Section 4.0. Section 5.0 of the EA addresses cumulative impacts for all relevant past, present, and reasonably foreseeable activities on BLM-administered and private lands. BMPs have already been incorporated into the Proposed Action. The No Action Alternative has also been presented for comparative purposes. Finally, the original company proposed project was considered, but eliminated from further consideration after BLM identified numerous impacts that would have occurred to environmental resources.
2-27	At 17,000 acres, 120 well pads (with the number of actual potentially ranging upwards of 1,000 or more), 62 miles of road of road construction, 71 miles of pipeline, and two compressor stations, we feel the direct impacts of this project alone represent a significant impact on the human environment.	The 17,000 acres mentioned is approximately the size of the entire Project Area, of which, only about 5 percent would be directly impacted over the short-term; even less over the long-term. The Proposed Action would involve installation of 120 well pads only. Nowhere in the EA is the potential number of wells or pads identified at upwards of 1,000. Since the scope and nature of this project is well within the oil and gas development scenario envisioned by the BLM in its 1997 Resource Management Plan and EIS, review of the project in an EA is appropriate.
2-28	Wildlife habitat loss, especially for big game and sage grouse, is estimated in the thousands of acres. The various cumulative and irretrievable effects to land, water, air, recreation—not to mention the potential permanent loss of cultural resources—leads us to feel that the environmental impact to these 17,000 acres is significant.	The assessment of impacts to wildlife habitat considered the types of habitats potentially affected and the overall availability of those habitats within and near the Project Area. As described in Section 4.9.1.2, the project would only result in direct and indirect losses of 0.13% and 0.65% of elk summer range throughout Game Management Units #31 and #22, which contain the Project Area. Direct and indirect impacts to mule deer summer range would be slightly less. Furthermore, this loss of mule deer habitat is well below the 10% habitat loss limitation stated as a planning objective in the BLM's 1997 White River RMP and EIS. While direct and indirect impacts to sage-grouse habitat are also numerically large, several mitigation measures were developed by the BLM and Colorado Division of Wildlife to substantially reduce the severity of impacts, including timing limitations for ground disturbing activities, closure of access roads with gates, netting of reserve pits, use of remote telemetry to reduce well visits and vehicle

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		traffic, reclamation program that emphasizes sage brush replacement in sage-grouse habitat, and funding for a study and off-site habitat improvement. Again, the 17,000 acres mentioned is approximately the size of the entire Project Area, not the area that would actually experience direct or indirect impacts. Compliance with preservation laws will minimize or prevent loss of cultural resources.
2-29	Beyond the boarders of this project, however, it is reasonable to conclude that new gas developments on this scale are the future gas booms driving the two current high capacity gas transmission lines slated for construction from Rio Blanco County through Moffat County and into Wyoming. In our view, this project is a major contributor to not only the transformation of this landscape from "generally wild to relatively industrialized" (EA at 4-41) but also the hundreds of miles of direct, indirect and cumulative impacts associated with this same operator's proposed transmission pipeline.	See response to comment 2-5.
2-30	Therefore, after reviewing this EA and considering the circumstances, we conclude that additional analysis is required and that an EIS is more appropriate for this level of development, which will radically alter the public lands in this area for decades if not for ever.	See response to comment 2-1.
Comment Letter 3 – Robert Tobin, General Comments		
3-1	US BLM must address the accumulative impacts of this project and many others proposed for the basin, I believe EA documents and extensive monitoring were required for just two local oil-shale projects in the 1970's-80's. The scopes of the current and proposed oil and has projects seem much greater.	Cumulative impacts associated with the proposed project and other past, present, and reasonably foreseeable future actions in the area are addressed in Chapter 5.0 of the EA. The cumulative impacts analysis included the Proposed Action, plus potential future expansion of the Proposed Action, additional natural gas drilling and production outside of the Figure Four Unit on federal and private locations, and other BLM and private activities such as livestock grazing, road improvements, and recreational activities. This analysis envisioned all aspects of additional gas development, including roads and pipelines and their related cumulative impacts.
3-2	Are US BLM and EnCana willing to honor the spirit/regulations of the Rio Blanco County Use Resolution regarding outdoor lighting and other issues? What about mayor impacts/cost to county infrastructure?	As described in Section 3.11, EnCana presently holds a county-wide Special Use Permit Operators License for its gas development activities in Rio Blanco County, which would authorize development of the proposed project, provided the conditions in the license are complied with. Development of project-related

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		facilities in Rio Blanco County would be done in compliance with applicable sections of the Rio Blanco County Land Use Resolution. See response to comment 1-30 for a discussion of costs related to county infrastructure.
3-3	Does the US BLM require environmental/impact bonds from companies prior to project development? Are these monies available to local residents in case of unsettled damage claims to private lands?	See response to comment 2-11. For natural gas wells and related infrastructure on privately-owned surfaces, the operator and the land owners typically enter into Surface Damage Agreements, which outline how development on private property is to take place and compensation for damages that may occur, such as damage to crops, improvements, and any loss of income from using the land.
3-4	Who will police/monitor potential impacts from this and similar proposed projects…location of sites, frequency of sampling, impartiality, etc.	The BLM would conduct routine inspections of the Figure Four Project Area as part of its Inspection & Enforcement (I & E) strategy for natural gas projects in the White River Field Office area. Application of the I & E process to the Figure Four Project would assure that required mitigation measures and conditions of approval are complied with by EnCana and its contractors or enforcement actions would be taken.
3-5a	The hydrological database is incomplete (sites, period of record). Data from many continuous and intermittent stream flow gaging stations, along with periodic water quality analyses, from areas down gradient from the project site were omitted… i.e., Stewart, Sorghum, Cottonwood, Scandard, Willow, and Black Sulphur Creeks. Spring data from these drainages also are not presented. Data for these sites are available from the US Geological Survey Database.	Hydrological data presented in the EA has been augmented with data from the USGS gaging stations at Black Sulphur Creek and Willow Creek. Data are not available for Sorghum, Cottonwood, and Scandard Creeks. Tables 3-2, 3-3, and 3-4 have been updated to include streamflow and water quality data for the entire period of record for five gaging stations.
3-5b	Terminology at times is inaccurate or misleading… i.e., discharge, means, alkalinity, sediment loads. (see comments on the attached copies of text pages.)	The text has been revised to clarify the terminology as suggested in Sections 3.4 and 3.5.
3-5c	Contradicting or inaccurate statements (see pages 3-9, 3-14, 3-16).	The text has been revised as discussed with Mr. Tobin.
3-5d	Data comparisons are very limited when collected from different time periods, from different hydrologic events, from distant locations, or from conditions not representatives of their environment. (see pages 3-9, 3-10, 3-14, 3-15 and 3-16)	Additional hydrologic data representing the entire period of record have been added to Tables 3-3 and 3-4. The text has been revised to include discussion of these data.
3-5e	Tables often unclear or missing footnote assignments.	Tables 3-2, 3-3, and 3-5 have been revised to clarify footnote assignments.
3-5f	The implied procedures presented in this EA for calculating means using less than values can result in very inaccurate	The method for calculating means has been changed to be more representative of the data. Summary statistics have been included in Tables 3-3 and 3-4 to show the

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	data ranges within the database. If analytical methods, having poor, low end sensitivities are used in this process, values much greater than actual background concentrations may be reported.	number of samples, number of detects, range of results, and mean for each parameter. For parameters with large numbers of non-detect data, the mean was calculated using only the positive results.
3-5g	A careful review of data presented in table 3-8, and data comparisons of table 3-8 with tables 3-5, and 3-6 indicate that impacts from outside sources may have already occurred within the project site. (see comments on attachment)	We disagree with this statement. Published reports concerning the hydrology of the Piceance Basin have documented large variations in the groundwater chemistry and high concentrations of some parameters, including TDS and fluoride, especially in the lower aquifer. The elevated dissolved solids seen were attributed to dissolution of sodium minerals from the deposits of nahcolite present beneath the area and other natural factors. The published reports do not suggest that any "impacts from outside sources" have occurred.
Comment Letter 3 – Robert Tobin, Specific Comments **Page, Paragraph, Sentence**		
1-2	What about accumulative impacts of many such projects?	See the response to comment 1-2.
1-2	What about environmental bond posting?	See the response to comment 2-11.
1-2	Must have good data base to measure impacts	The EA utilized a wide variety of data sources for presentation of the affected environment and as a basis for environmental effects analysis. Where the adequacy of data has been questioned in comments on the EA, additional data have been compiled and utilized and incorporated into the document in Sections 3.4 and 3.5.
1-2	Need to address dark sky environment. RBC regulations on lighting per its Land Use Res.	See the response to comment 3-2 regarding compliance with the RBC Land Use Resolution. Sections 4.13.1 and 4.13.4 discuss potential impacts and mitigation measures related to night lighting, respectively.
2-5, 5, 6	H_2S encountered during USGS drilling. Drilling depths generally less than 2,000 ft.	Comment acknowledged. It is possible low concentrations of hydrogen sulfide may be encountered in drilling proposed wells, although EnCana has not encountered it in wells drilled to date in this part of the Piceance Basin.
2-6	Who will police all this, how often will checks occur?	See the responses to comments 1-23 and 1-33.
2-6, 5	Who or what guarantees this?	See the response to comment 1-33.
3-1	Where Shown? X-section would be informative.	Figure 3-2 provides a stratigraphic column for the Piceance Basin.
3-2, 4, 1	Upper Cretaceous?	The text has been revised to state that sediments range in age from Late Cretaceous to middle Tertiary.
3-8, 8	ILES fm?	The text has been revised to include the Iles Formation.
3-4, 6, 1	Dinosaurs?	The reference to dinosaurs was for the White River Resource Area generally, not

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		specifically the Piceance Basin. The text has been revised to delete the reference to dinosaur fossils.
3-8, 1, 7	Original reference.	The reference has been changed to Robson and Saulnier (1981).
3-8, 3, 2	Fawn Creek, East Fawn Creek are tributaries to Black Sulfur Creek, which is a tributary to Piceance Creek.	The text has been revised to state that Fawn Creek and East Fawn Creek are tributaries to Black Sulphur Creek.
3-8, 3, 5	Should address general local area. What about Willow Creek, Black Sulfur etc…	The text has been revised to include Black Sulphur and Willow Creeks
Table 3-2	This column (range of discharge) shows a range of annual mean discharge – you should show a range for daily mean or instantaneous discharge.	The table has been revised as discussed with Mr. Tobin to include a range of daily mean discharge for each station.
3-10, 2, 2	Define (F, X, Cl - hardly principle)	The text has been revised to delete fluoride from the list of principal ionic constituents.
3-12, 2, 6	But most values are less than 8-5.	The text has been revised to state that most pH values are below 8.5.
Table 3-3	• There are many data collected over a range of many years; this table should summarize that. • Data summary should to be for period of record; this table is incomplete • See mean comment • Where are data for site 09306061?	Table 3-3 has been revised to include summary statistics for the entire period of record for five USGS gaging stations, including those on Black Sulphur Creek and Willow Creek. The method of calculating means has been changed as discussed in the response to General Comment 5f, above.
Table 3-4	It seems some what alarming that these procedures still continue in EA/EIS documents addressing water quality in Piceance Creek basin. See “7” below should not be allowed could be like calculating mean new born baby using truck scales. Inaccurate back ground date range can be created using poor sensitive analytical methods.	Table 3-4 has been revised to include summary statistics for the entire period of record for the USGS gaging station on the White River. The method of calculating means has been changes as discussed in the response to General Comment 5f, above.
3-13, 1	Why not use period of record or existing USGS reports. Where are data for Na, K, HCD3, Dl, SOx, etc… use period of record.	See response to comments above.
3-13, 4, 3	How do you know this reference?	Robson and Saulnier (1981) is USGS Professional Paper 1196. The reference citations have not been changed.
3-14, 1, 2	Where unfractured	The phrase “Where unfractured” has been added.
3-14, 2	Although often used for domestic purposes	The phrase “Although often used for domestic purposes” has been added.

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3-14, 2	But are these data representative of the project area? Probably not. Contradiction	The data presented are those available in published reports and are assumed to be representative of the groundwater conditions beneath the Project Area.
3-14, 4	Data indicate major GW type variations – tributaries GW data suggest significant impacts from outside sources. See tables 3-3, 3-6	We disagree. See the response to General Comment 5g, above
3-14, 4, 2	Why not report and compare data with Nevada or Utah data? Should stay within local area for data comparison.	Comment noted.
3-14, 5	In bore solution	The text has been revised to state that the high TDS values were obtained from open boreholes and may not be representative of groundwater conditions within the Lower Aquifer.
Table 3-5	Aren't these wells USGS? When were data collected, to recently?	We are not aware of any more recent USGS sampling of groundwater wells within the basin.
Table 3-6	Data terribly misleading - ? mostly resulted from in bore solution. Data shown in table 3rd time more representation of most areas in Piceance Basin.	The data are presented as published by Weeks et al. (1974). The locations of the wells are provided in the referenced document.
3-15, 1	Where are these shown on maps?	The locations of the wells are provided in the referenced document. The method of calculating means has been changes as discussed in the response to General Comment 5f, above.
3-16, 1, 1	Are there additional unmapped springs	We are unaware of any additional spring mapping in the area.
3-16, 1, 2	Data for mapped. No! No! see + compare data shown in table 3-8 and compare with 3-5 and 3-6.	As discussed with Mr. Tobin, Table 3-8 has been deleted from the document. Discussion of the spring water quality has been deleted from the text.
3-16, 1	Immeasurable because discharge area was very large or very small.	The text has been revised to state the flow range as "<1 to 109 gallons per minute".
Comment Letter 4 – Tim Mantle		
4-1	There is a definite down-play of the use of Federal Land Allotments as well as Private landowners and Leasees of private lands and grazing allotments in the document provided.	The EA acknowledges private ownership of much of the surface of the Project Area and that grazing is a major land use on public and private surfaces. Sections 3.8.4 and 3.11.1 acknowledge existing agricultural and grazing-related land uses in the Project Area.
4-2	In order for the Federal Government to lease its minerals to private industry, there has to be consideration given to the impact of those who are grazing livestock in the area of surface disturbance.	Section 4.8.1.4 describes potential impacts to rangeland resources and grazing. That section of the EA has been revised to include the number of AUMs that would be lost in each of the two grazing allotments. That information is presented above in response to comment 1-28.
4-3	At the public meeting 8/18/2004 there was talk by the Area Manager that there would be impacts, however not very	See responses to comments 1-28 and 4-2.

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	significant, to the Allotments in the area. Not very significant to whom? Is this an overall statement directed at the entire Grazing Area administered by the Meeker Office concerning a few hundred AUMs or is this directed for instance at one allotment of a few hundred AUMs which will ultimately destroy that particular ranch?	
4-4	Is this disturbance and consequential loss of AUMs going to be limited to Federal AUMs on that particular allotment or will it also cause a loss of AUMs of private production where Federal Mineral Leases and associated infrastructure disturbs Private Surface ownership?	The discussion of impacts to range resources and associated loss of AUMs described above includes both federal and privately-owned range resources/AUMs.
4-5	Then consider the relocation of Wildlife onto adjoining lands and consider the surface impact and consumption of forage and water thereby putting strain on adjoining allotments. Therefore there will have to be forage enhancement also on adjoining allotments.	The displacement of wildlife from the Project Area to adjacent grazing allotments would not produce a measurable decline in AUMs available on those surfaces. Mule deer are a browse species that do not share the same diet as cattle. Increases in mule deer would therefore have no effects on grasses available for grazing. Although some elk may move to adjacent allotments for grazing, the majority would most likely remain in the Project Area. If movements did occur, they would only be temporary as elk would most likely return to areas within the Project Area after construction activities ceased at a given location.
4-6	All Allotments could use some creative management. There are places that forage could be enhanced and there are many places that the provision of water would accomplish this goal. There are roads and drilling pads to be built and with the natural drainage of a hard surface, everyplace there is a drain ditch, there should be a small reservoir (catchment) constructed. These catchments will not all be functional to hold water, so when the roadways/pads are down sized or reclaimed, delete those which are non-functional and enlarge those that are productive.	Small catchments/water impoundments along drainage ditches to improve range conditions, where appropriate, will be encouraged by BLM and added as a mitigation measure in Section 4.8.3.4.
4-7	When these pipelines are installed there should be provision made to install water pipeline also in the trench if the direction is toward a place that could be further developed to enhance grazing capabilities for domestic or wildlife. It is feasible to pump water and more economical and with less	Comment noted. The installation of water lines to support livestock grazing is outside of the scope of this project.

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	surface impact than hauling water.	
4-8	It is incumbent upon the BLM to address and resolve all issues that arise as a result of their (BLM) leasing their (BLM) Oil and Gas to Production Companies. It is absurd to expect the leasing company to mitigate the allotees as the leasing company is leasing a product (namely minerals from the USA), it is also absurd for the BLM to assume that they (BLM) do not have to mitigate the losses of the allotees. To ignore this obligation to those who own control those affected allotments (however far the cause and effect should travel) will constitute a Taking. See Hage v US.	See response to comment 1-28 and 4-2. Comment noted.
Comment Letter 5 – EnCana Oil and Gas (USA)		
5-1	Sections 2.2.1 and 2.2.1.1: Factors affecting the timeframe of drilling and completion activities will also include commodity price and rig availability. Sections 2.2.1 and 2.2.1.1 should be revised to reflect this.	Sections 2.2.1 and 2.2.1.1 have been revised to reflect this comment.
5-2	Section 2.2.1.2, second paragraph, first sentence should read "*Directiona**ly** drilling multiple wells…*"	Section 2.2.1.2 has been revised to reflect this comment.
5-3	Section 2.2.4, third paragraph, first sentence should be revised to read "*EnCana would maintain the access roads as necessary to prevent soil erosion, and accommodate project-related traffic.*" EnCana is not responsible for maintaining road damage caused by private landowners, hunters or other non-project related traffic.	Section 2.2.4 has been revised to reflect this comment.
5-4	Section 2.2.5, paragraph 3 should be revised to begin "***As required or necessary**, EnCana would implement the policies/practices…*" Language should also be added to this section to the effect that when feasible and applicable, EnCana would apply for exceptions, modifications and/or waivers to BLM surface stipulations.	The EA has been revised to reflect the first part of the comment. Section 2.2.5 already states that most surface stipulations can be excepted, modified, or waived.
5-5	Section 2.2.5, bulleted stipulations: Please confirm White River ROD/RMP language of NSO-02, NSO-03, NSO-08, TL-01, and TL-04. Should these stipulations be revised to read "occupied" nests or habitats? Lease stipulations in	For NSO-02, NSO-03, TL-01, and TL-04, the specific language in the ROD/RMP refers to "identified nests", as opposed to "occupied nests". Identified nests mean functional nests that could be used, whether occupied or not. In the event a raptor nest is identified in the field near a well location proposed for construction and/or

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	Section 2.2.6.2 under Raptors clearly stated "*no development would occur within ¼ mile of occupied raptor nests…*"	drilling, the nest would have to be evaluated to assess whether or not it is functional. If it is determined to be a functional nest, the stipulation(s) would apply. If the nest is determined to be no longer functional (abandoned), the stipulation(s) would not apply. For NSO-08, the specific language in the ROD/ RMP states "No surface occupancy will be allowed on mapped populations of these plants". Section 2.2.5 has been revised accordingly. Section 2.2.6.2 was in error and has been corrected to replace "occupied" with "identified" to accurately quote the stipulation.
5-6	Section 4.0, 4.9.1.3, 4.9.1.4, 4.9.1.5, and 4.9.4.1 cite Applicant Committed Environmental Protection Measures in Section 2.2.7. This EA does not include any Applicant Committed Environmental Protection Measures, only measures that are required in the ROD/RMP and leases. Furthermore, there is no Section 2.2.7.	All references to "Applicant Committed Environmental Protection Measures" in Section 2.2.7, have been corrected in the EA and now refer to "Federally Required Environmental Protection Measures" in Section 2.2.6.
5-7	Section 4.7.3 last paragraph should read "*or earth**en** berms*."	The EA has been revised to reflect this comment.
5-8	Section 4.8.1.3, second paragraph should be revised to clarify that EnCana would only be responsible for funding weed control on private lands where EnCana actions have caused weed infestation and have not been corrected by EnCana. As it reads now, the document insinuates that EnCana could be responsible for funding weed control on private lands, even where EnCana actions have not cause weed infestation.	Section 4.8.1.3 has been revised to reflect this comment.
5-9	Section 4.8.1.5, second paragraph should be revised to state that wetland delineations were prepared and were conducted.	The EA has been revised to reflect this comment in both sections 3.8.5 and 4.8.1.5.
5-10	Section 4.8.3.1, second paragraph includes sentence fragments. Please revise appropriately.	Section 4.8.3.1 has been revised to address this comment.
5-11	Section 4.8.4: These mitigation measures are duplicates of those discussed in Section 4.8.3. Please delete them.	Section 4.8.4 has been deleted.
5-12	Section 4.9.3.3, first paragraph, second sentence: Please revise to read "*EnCana **should fund an annual raptor nest inventory** of their Figure Four Project Area and a one-mile radius during the **3 to 4-year** drilling and construction phase*." The third sentence of this paragraph should be corrected to "…identify additional nests."	The EA has been revised to reflect this comment. Annual surveys are required for any disruptive land use activity during the length of the construction phase.

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5-13	Section 5.1.1.5, second sentence should read, "…*it is expected to* ***be*** *minimal*…"	Section 5.1.1.5 has been revised to reflect this comment.
5-14	Section 5.9.1, first paragraph: remove parentheses around CIAA.	Section 5.9.1 has been revised to reflect this comment.
5-15	Section 5.9.1.1, first sentence should read "*because of their limited exten**t**…*"	Section 5.9.1 has been revised to reflect this comment.
5-16	Section 5.9.2.1, second sentence should read "*These **e**ffects…*"	Section 5.9.2 has been revised to reflect this comment.
5-17	Section 5.11.2, first sentence: remove parentheses around ACECs.	Section 5.11.2 has been revised to reflect this comment.
5-18	Section 5.15: Clarify that additional development in the CIAA would have a beneficial cumulative impact on socioeconomic resources.	Section 5.15 has been revised to reflect this comment.
5-19	Comments on Vehicle Traffic References: The EA has several discussions on vehicle traffic associated with project operations. The first paragraph in Section 2.2.2 states that there would be approximately 20 round-trips per day during the operational phase. The fifth paragraph in Section 2.2.2 then insinuates there would be 3 round-trips per day for maintenance visits, while the following paragraph states that maintenance visits would be limited to two round-trips per week because of remote telemetry. Section 4.9.3 and 4.9.4.3 discuss 4 round-trips per day for well site visits. Daily or weekly well-site traffic for operations should be clarified with the EnCana Rifle Office and discussions in the EA should be revised appropriately.	Section 2.2.2 provides an overview of all operational vehicle trips expected for the proposed project, which is based on discussions with the EnCana Rangely Office. In total, 20 vehicle roundtrips per day are anticipated: 11 condensate haul trips, 5 produced water haul trips, 3 maintenance/pumper trips, and 1 workover/delivery trip. The last paragraph in Section 2.2.2 refers to remote telemetry and was intended to mean that the use of telemetry would reduce visits to each well site from every day to once or twice per week. Section 4.9.3 is specifically referring to well site visits that would be reduced due to remote telemetry (excludes the 16 condensate and produced water haul trips per day that would not be affected by the use of telemetry).
5-20	General Comments on Mitigation: There is conflicting mitigation language throughout the EA. Several the stated mitigation measures use "would", while others use "should." If the cited mitigation measures are not required by the White River ROD/RMP, lease stipulation, law or regulation, or already committed to by EnCana, these statements should be revised into suggestions; i.e., they should use "should" instead of "would".	All mitigation language in the EA has been reviewed and corrected where appropriate.

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5-21	General Comments on Section Number References in EA: The EA needs a thorough review and editing of section number references. There are numerous references to sections that are incorrect. For example, Section 4.15.1.3 refers the reader to Section 4.14.4 when it should refer the reader to Section 4.15.3. Similarly, Section 5.10 refers the reader to Section 4.11.3 when it should refer them to Section 4.10.3.	All section number references have been checked and corrected where appropriate.